

Diabetes in the indigenous population of the Commonwealth of the Northern Mariana Islands

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Introduction

Throughout the islands of the Pacific there has been a general shift of morbidity and mortality away from perinatal causes and infectious diseases and toward chronic, non-communicable diseases. Diabetes is an especially important chronic disease in the Commonwealth of the Northern Mariana Islands (CNMI), as it is throughout the Pacific region. To date, no systematic examination of the problem of diabetes in the CNMI had been conducted. Published recommendations for preventive health care and screening for diabetes are based on patterns of disease found in cosmopolitan populations. Pacific communities may exhibit important differences and the ideal approach to diabetes control might therefore also differ. With this in mind we have compared patterns of diabetes prevalence and its complications in our population with those of a cosmopolitan population (that of the U.S.). This study was undertaken in the hope of identifying opportunities for decreasing the toll inflicted by this disease on the people of the CNMI.

Of the estimated CNMI population of 56,647 people, 44% are considered indigenous (21,282 Chamorro and 3,316 Carolinian). Over 90% of the indigenous population live on the island of Saipan. During the years of this study, 1992-95,

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there was very little private medical care delivered in the CNMI and the large majority of residents obtained outpatient care at a single site, the Commonwealth Health Center (CHC). Essentially all residents also received inpatient, obstetrical, dialysis, ophthalmic and surgical care at the CHC. Aside from the indigenous population of Chamorros and Carolinians, the population is young and highly transient. Most are brought in for short periods of time as contract workers in the government, tourism and garment industries.

Most of the data used in this study comes from the central computer system at CHC. Demographic information about patients and data about medical encounters and billing information had been entered for 3 years, since installation of the system in March of 1992. Eighty-six percent of the indigenous population of the CNMI have medical entries in the central database. Diagnoses are coded in the database according to the International Classification of Diseases (ICD-9). The availability of a single, computerized repository of medical data for the majority of health service encounters of the population presents a rare opportunity for study of diabetes and its complications.

Methods

Except as otherwise noted, the indigenous population refers to residents of the CNMI identifying themselves as ethnically Chamorro or Carolinian (as per the 1992 CNMI Current Household Survey or as recorded in the central database at the CHC).

The central database was used to identify subjects in this population with diabetes and its complications according to the appropriate ICD-9 codes (see Annex A). These data were supplemented by information from logbooks kept in the hemodialysis unit, surgical suite, and nursery and by death certificate data from the CNMI office of vital statistics. Data about diabetic retinopathy and eye disease are based on the examinations performed by the single ophthalmologist practicing in the CNMI during this period. Most of these

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examinations were done in the setting of a diabetes eye disease screening clinic wherein known diabetics are systematically screened for eye disease.

Results

Prevalence of diabetes

In all ethnic groups there are 1318 known Type II diabetics. Of these, 975 are indigenous with 796 (82%) Chamorros and 179 (18%) Carolinians.

Fifty-eight percent of indigenous diabetics are women. This preponderance holds for both Chamorros and Carolinians. For all ethnic groups and for both sexes, the age category of 45 to 64 years has the greatest number of cases and the highest rates of diabetes.

The age adjusted prevalence rate in the indigenous population is 9.3% (the crude rate is 4.0%). Age adjusted rates for the Chamorro and Carolinian populations are 9.0% and 11.3%, respectively. Eleven percent of indigenous adults over 25 years of age have diabetes. The highest age specific rate is found in Carolinian

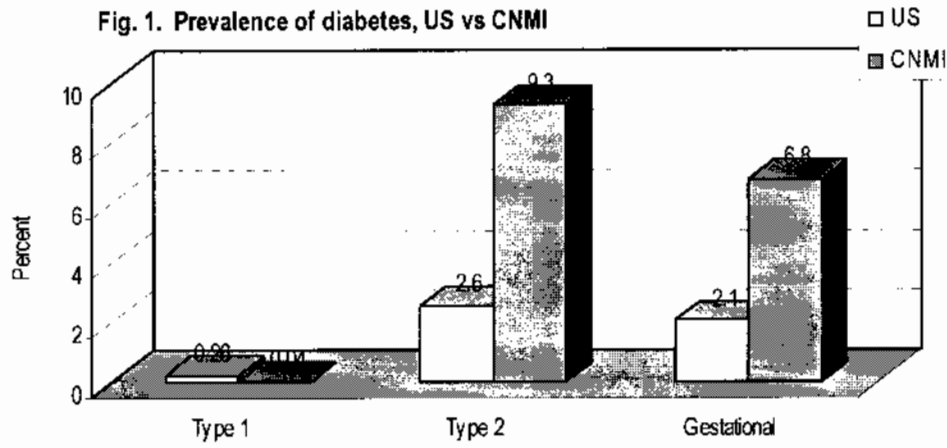
ANNEX A. ICD-9 codes used for identifying diagnoses and complications of diabetes mellitus

Condition	Codes
Diabetes Mellitus (all types):	250.00-250.93
Type I Diabetes:	250.01 (verified by queries to all primary care physicians at CHC)
Gestational Diabetes:	Codes not used; data from labor and delivery unit/ nursery log books.
Amputations:	84.10-84.19 (verified by review of surgery unit log books).
End Stage Renal Disease:	Codes not used; data from dialysis unit log books.
Diabetic Ketoacidosis:	250.10-250.13
Diabetic Retinopathy:	362.01 (background retinopathy); 362.02 (proliferative retinopathy)
Blindness:	369.00-.08; 369.10-.18; 369.60-.69
Ischemic Heart Disease	410.00-414.90
Stroke	430-438
Pneumonia	482.0-482.9
Influenza	487.0, 487.1, 487.8

Table 1. CNMI Type II diabetes mellitus prevalence rates, 1994

Age		Overall	0-44	45-64	65+	Age adjusted*
Indigenous population	#	975	265	495	215	9.3
	Rate %	4.0	1.2	22.6	32.6	
Chamorro	#	796	204	397	195	
	Rate %	3.7	1.1	21.0	32.9	9.0
Female	#	458	117	208	133	
	Rate %	4.4	1.3	23.3	40.6	
Male	#	338	85	188	65	
	Rate %	3.1	0.9	18.7	24.6	
Carolinian	#	179	61	98	20	
	Rate %	5.4	2.1	33.2	29.9	11.3
Female	#	104	33	56	15	
	Rate %	7.1	2.5	42.1	53.6	
Male	#	75	28	42	5	
	Rate %	4.1	1.7	26.3	12.5	

* Adjusted to 1980 United States population



Type 1 and Type 2 are age-adjusted to 1980 U.S. population.
Gestational refers to % of women delivering who have gestational diabetes.

women 65 years and over, 53.6% of whom are known to have diabetes. (see Table 1)

The age adjusted rate for the entire U.S. population in 1990 was 2.6%. (Prevalence of persons with known diabetes adjusted to 1980 U.S. population).

Incidence rates

In 1994, 56 new indigenous diabetics were identified in the CNMI (2.1 per 1000 population). The incidence rate for Chamorros is 1.6 and for Carolinians is 4.8 per thousand. Most new cases are identified in the 45-64 age group.

The incidence rate for the entire U.S. population in 1990 was 2.44 per 1,000.¹¹

Type 1 diabetes

There were 4 known cases of Type I diabetes in the CNMI at the end of 1994. All were Chamorro; 3 females and 1 male, ranging in age from 10 to 20 years. The prevalence rate for Type I diabetes in the indigenous population of the CNMI is 0.4 per thousand.

The corresponding rate for the U.S. population is 2.6 per 1,000.¹²

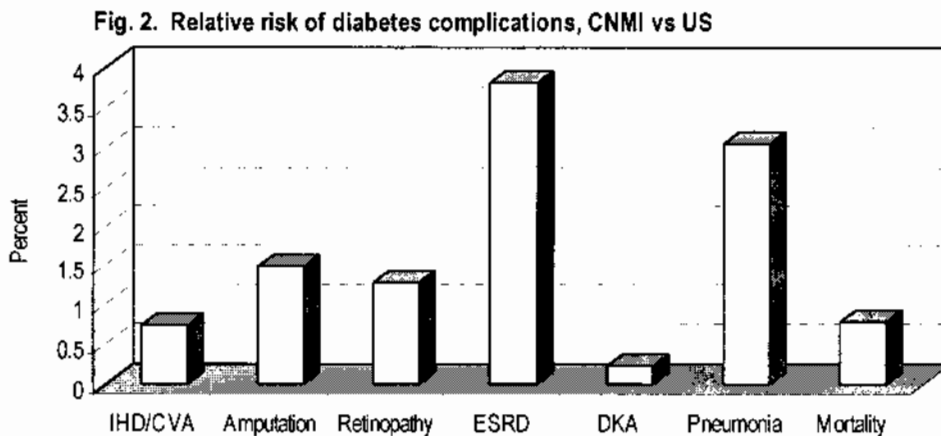
Gestational diabetes

In 1994, 7% (38 of 561) of indigenous women who gave birth had gestational diabetes (5% and 7% for Chamorros and Carolinians, respectively). Eight (21%) of these babies weighed more than 9 pounds. Five percent of infants of indigenous non-diabetic mothers in the CNMI weigh more than 9 pounds. There were 2 deaths of infants of diabetic mothers in 1994. The number of fetal deaths to diabetic mothers is not known.

In the U.S. 2.1% of women giving birth have gestational diabetes.¹³

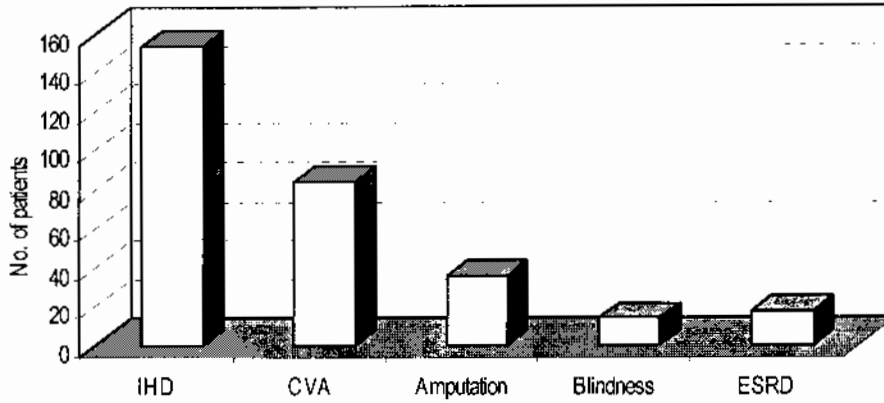
Mortality rates

Among the indigenous people an average of 16 deaths per year over the three years occurred for which diabetes was cited as either a primary or contributing cause, for a diabetes related death rate of 67 per 100,000 population



ESRD = end stage renal disease; DKA = diabetic ketoacidosis;
IHD/CVA = hospitalization for ischemic heart disease and cerebrovascular accident.

Fig. 3. Selected complications, CNMI indigenous population



IHD= hospitalization for ischemic heart disease; CVA= cerebrovascular accident; ESRD= end stage renal disease)

per year . Of these 48 deaths, 38 (61.3/100,000 per year) were Chamorro and 10 (103.6 /100,000 per year) were Carolinian.

*The diabetes related death rate for the U.S. population in 1989 was 79.1 per 100,000.*¹⁴

Amputations

Among indigenous diabetics an average of 12 non-traumatic amputations of any part of the lower extremities were performed over the past three years for a rate of 12.3 per 1,000 diabetics per year.

*In the U.S. the rate of hospital discharges for nontraumatic lower extremity amputation per 1,000 diabetics is 8.3 per year.*¹⁵

End stage renal disease (ESRD)

Eighteen of the 975 known indigenous diabetics in the CNMI are currently on dialysis for ESRD (prevalence of 18 per 1000 diabetics). Eight of these patients initiated dialysis in 1994 (incidence of 8 per 1000 diabetics). Of all patients on dialysis in the CNMI, half have kidney failure due to diabetes.

*The comparable rate for initiation of treatment for end stage renal disease in the United States in 1989 was 2.08 per 1000 diabetic population.*¹⁶

Diabetic ketoacidosis (DKA)

Through the central database three indigenous people were identified with DKA in 1994. This equates to an incidence of 3 per 1,000 diabetics.

*This compares to the United States rate of 12.7 per 1,000 diabetic population per year.*¹⁷

Eye disease

Of 975 known indigenous diabetics, 339 were screened for retinopathy; Among these 339 patients the prevalence of categories of retinopathy are as follows:

- Any diabetic retinopathy 236 (70%)
- Background diabetic retinopathy..... 201 (59%)
- Proliferative diabetic retinopathy.....35 (10%)

A more conservative estimate of the prevalence of diabetic retinopathy is derived by dividing the numbers of those known to have retinopathy by the entire population of 975 (whether screened or not):

- Any diabetic retinopathy (24%)
- Background diabetic retinopathy..... (21%)
- Proliferative diabetic retinopathy.....(4%)

The World Health Organization's defines blindness as vision of 20/400 or worse in at least one eye. According to this definition 14 (1.4%) of indigenous diabetics are known to be blind as a result of their diabetes. Of all cases of blindness in the indigenous population 40% are attributable to the effects of diabetes.

*Among U.S. diabetics 54% have any category of retinopathy while 8% have proliferative retinopathy.*¹⁸

Ischemic heart disease and stroke

Of the indigenous diabetic population in the CNMI 154 (16%) are known to have ischemic heart disease and 84 (9%) have had strokes. In the non-diabetic indigenous population over 34 years of age, these rates are 5% and 3% respectively. An average of 10 (1%) indigenous diabetics per year have had hospitalizations for stroke or myocardial infarct over the three years.

*Among U.S. diabetics 1.25% are hospitalized for ischemic heart disease and stroke per year.*¹⁹

Hospitalizations for lower respiratory infection

An average of 89 (9.1%) of indigenous diabetics have been hospitalized per year for pneumonia or influenza over the three years.

*Among U.S. diabetics 3.0% are hospitalized per year for diseases of the respiratory system.*²⁰

Discussion

In this study, 4% of the indigenous population of the CNMI was found to have diagnosed diabetes. The true prevalence of diabetes in the population is likely to be greater since there are almost certainly many people who are affected but undiagnosed. In many community-based surveys over 50% of diabetics had not been previously diagnosed.²¹ In interpreting this prevalence rate it is also important to consider that the indigenous population in the CNMI is a "young" one, with only 9% aged more than 45 years.²² The onset of disease in most diabetics occurs after the age of 45 years in the CNMI, as it does in most populations. If current age-specific rates remain unchanged in the CNMI and as the age distribution of the population approaches that of the U.S., the prevalence of diabetes can be expected to rise to 9.3%.

Our finding of an 11% prevalence rate of diabetes among indigenous adults is consistent with the high prevalence rates of diabetes in adults elsewhere in the Pacific, which range from 2% to 37%.²³ In contrast, Type I diabetes is quite rare in the CNMI; this is in keeping with studies within other Pacific nations.²⁴ This low prevalence of Type I diabetes explains the low incidence of diabetic ketoacidosis in the CNMI, which occurs only rarely in Type II diabetics.

While the prevalence of Type II diabetes in Chamorros is high, it is even higher in Carolinians. It is also substantially more common among females, who account for 58% of the diabetes cases among the indigenous population in the CNMI.

The reasons that diabetes is more common in women and Carolinians in the CNMI are unknown but could be related to differences in diet, patterns of physical activity or care seeking behavior. A higher prevalence of diabetes among women has also been noted in some, but not all, studies of Pacific populations.^{25,26,27} In Tuvalu, part of the higher prevalence of abnormal glucose tolerance among women was related to higher rates of obesity compared with men in that population.²⁸ With a prevalence rate of 44%, the rate of diabetes in Carolinian women over 45 years of age is especially striking.

Compared to the U.S. population, diabetes in the CNMI is much more prevalent and is more likely to result in pneumonia, kidney failure, retinopathy, and amputations. The reasons for these differences are not clear but could be related to differences in lifestyle, self-care among known diabetics,

use of medical services or in genetic susceptibility. Because disease prevalence is so much higher, it makes more sense to screen for diabetes in CNMI than in the U.S. Greater efforts are also warranted to assure immunization with influenza and pneumococcal vaccines and to limit renal and eye damage by placing special emphasis, perhaps by tracking of patients, on control of hypertension and eye surveillance of diabetics. Finally, medical care providers should make a special effort to examine the feet of diabetics in their care at every opportunity. Patients should be counselled regarding foot care in accord with island lifestyles - e.g. footwear should be recommended with regard to what is locally available. Also, since diabetics are much more likely

than mainland residents to live in proximity to farm animals they should be made aware that soil contaminated with animal droppings is very likely to give rise to invasive infections when it comes into contact with minor abrasions of the foot.

Diabetes-related mortality and the incidence of hospitalization for ischemic

heart disease and cerebrovascular disease appear to be lower in this population than in the U.S. as a whole (though CNMI diabetics are still more likely to die of ischemic heart disease and cerebrovascular disease than any other conditions). Since these complications occur most commonly in older diabetics it is possible that the younger diabetics in the CNMI explains this apparent complication "deficit". The incidence of these events in the CNMI is not sufficiently large for the calculation of meaningful age adjusted rates. One powerful co-factor in causing vascular disease is tobacco smoking. While it is not known what proportion of diabetics in the CNMI are smokers, a survey of students revealed that 52% are smokers by the time they reach Grade 12.²⁹ Measures to decrease tobacco use might reduce these types of diabetes-related complications.

The large burden of cost, suffering, and death from diabetes on the indigenous population of the CNMI is not inevitable. In times past, when levels of physical exercise were higher, the local diet was based on local rather than imported foods. Obesity and diabetes and its complications were rare throughout the Pacific.^{30,31} At present, obesity is common in the CNMI and appears very early in life. A community based survey of 200 three and four year old children on Saipan in 1994 revealed that 7.2% are overweight (Z score more than 2 SD above ideal weight for height by WHO standards).³² Efforts at *primary* prevention of diabetes might be directed to the population from an early age.

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