Prevalence of Diabetes Among Native Americans and Alaska Natives, 1990–1997

An increasing burden

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OBJECTIVE — To determine trends in diabetes prevalence among Native Americans and Alaska Natives.

RESEARCH DESIGN AND METHODS — From 1990 to 1997, Native Americans and Alaska Natives with diabetes were identified from the Indian Health Service (IHS) national outpatient database, and prevalence was calculated using these cases and estimates of the Native American and Alaskan population served by IHS and tribal health facilities. Prevalence was age-adjusted by the direct method based on the 1980 U.S. population.

RESULTS — Between 1990 and 1997, the number of Native Americans and Alaska Natives of all ages with diagnosed diabetes increased from 43,262 to 64,474 individuals. Prevalence of diagnosed diabetes increased by 29%. By 1997, prevalence among Native Americans and Alaska Natives was 5.4%, and the age-adjusted prevalence was 8.0%. During the entire 1990–1997 period, prevalence among women was higher than that among men, but the rate of increase was higher among men than women (37 vs. 25%). In 1997, age-adjusted prevalence of diabetes varied by region and ranged from 3% in the Alaska region to 17% in the Atlantic region. The increase in prevalence between 1990 and 1997 ranged from 16% in the Northern Plains region to 76% in the Alaska region.

CONCLUSIONS — Diabetes is common among Native Americans and Alaska Natives, and it increased substantially during the 8-year period examined. Effective interventions for primary, secondary, and tertiary prevention are needed to address the substantial and rapidly growing burden of diabetes among Native Americans and Alaska Natives.

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The epidemic of type 2 diabetes is a worldwide phenomenon. Populations in developing countries and minority and disadvantaged populations in industrialized countries are at greatest risk (1). It is believed that lifestyle changes within these populations—characterized by diminished physical activity, increased calorie and fat consumption, and increased obesity—have interacted with genetic susceptibility to create an epidemic of diabetes. In the U.S., Native Americans suffer disproportionately from diabetes (2,3). The highest prevalence of diabetes in the world has been recorded among the Pima Indians of Arizona (4). Diabetes was rarely reported among Native Americans 50 years ago, but it is now a major cause of morbidity (such as blindness, kidney failure, lower-extremity amputation, and cardiovascular disease), disability, decreased quality of life, and premature mortality (5).

Surveillance of diabetes is critical to defining the burden of diabetes, planning health programs, formulating health care policy, identifying high-risk communities, assessing trends, and developing strategies to reduce the burden of this disease (6). National health surveys used to monitor diabetes in the U.S. population are not useful for monitoring diabetes prevalence among Native Americans and Alaska Natives because of small sample sizes. However, a previous study demonstrated the feasibility of using the national outpatient database of the Indian Health Service (IHS) for the surveillance of diabetes among Native Americans and Alaska Natives (3). No national estimates of diabetes prevalence among Native Americans and Alaska Natives have been published since then. We analyzed data from the IHS national outpatient database for the years 1990–1997 to estimate recent diabetes prevalence and document trends in diabetes among Native Americans and Alaska Natives served by the IHS and tribal health facilities.

RESEARCH DESIGN AND METHODS

Established in 1955, the IHS is an agency of the U.S. Public Health Service that provides comprehensive health care to Native Americans and Alaska Natives (7). Of the estimated 2.32 million Native Americans and Alaska Natives who resided in the U.S. in 1997 (8), 1.43 million (60%) resided on or near reservations with IHS or tribal health facilities (7). Of this group, ~1.29 million (90%) actually used these facilities for their health care (9).

The IHS outpatient computerized database contains clinical and demographic information on outpatient encounters—including laboratory and pharmacy data—in 541 IHS and tribal health facilities. The facilities are grouped into 151 service units (7). We analyzed IHS outpatient data from 105 (70%) of the 151 units, excluding data from 46 units (representing 16% of the

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Abbreviations: IHS, Indian Health Service.
A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

Table 1—*Native Americans and Alaska Natives with diagnosed diabetes and prevalence of diagnosed diabetes by sex and age-group, 1990–1997*

	Age-group (years)					
	<20	20–44	45–64	≥65	All ages	Adjusted*
Total						
1990	758 (0.17)	10,975 (2.84)	20,661 (15.21)	10,868 (18.21)	43,262 (4.17)	6.15
1991	790 (0.17)	11,368 (2.90)	21,455 (15.56)	11,122 (18.35)	44,735 (4.25)	6.26
1992	891 (0.19)	12,023 (3.00)	22,814 (16.19)	11,718 (18.90)	47,446 (4.41)	6.49
1993	931 (0.19)	12,899 (3.14)	24,508 (16.99)	12,462 (19.65)	50,800 (4.61)	6.78
1994	1,004 (0.20)	13,774 (3.29)	26,397 (17.94)	13,287 (20.54)	54,462 (4.85)	7.13
1995	1,029 (0.20)	14,399 (3.36)	27,688 (18.39)	13,961 (21.11)	57,077 (4.96)	7.31
1996	1,016 (0.20)	15,270 (3.50)	29,695 (19.39)	14,731 (21.89)	60,712 (5.19)	7.64
1997	1,051 (0.20)	16,343 (3.68)	31,407 (20.11)	15,673 (22.84)	64,474 (5.40)	7.95
Men						
1990	319 (0.14)	4,502 (2.38)	8,048 (12.56)	3,929 (15.51)	16,798 (3.30)	5.14
1991	333 (0.14)	4,743 (2.47)	8,349 (12.83)	4,009 (15.58)	17,434 (3.37)	5.24
1992	386 (0.16)	5,071 (2.59)	9,030 (13.58)	4,304 (16.35)	18,791 (3.55)	5.52
1993	371 (0.15)	5,497 (2.74)	9,902 (14.55)	4,647 (17.25)	20,417 (3.77)	5.87
1994	411 (0.16)	5,927 (2.89)	10,636 (15.32)	4,959 (18.05)	21,933 (3.97)	6.17
1995	445 (0.17)	6,240 (2.98)	11,286 (15.90)	5,244 (18.66)	23,215 (4.10)	6.39
1996	414 (0.16)	6,645 (3.11)	12,294 (17.02)	5,526 (19.33)	24,879 (4.32)	6.73
1997	453 (0.17)	7,040 (3.24)	13,224 (17.95)	5,825 (19.98)	26,542 (4.52)	7.04
Women						
1990	439 (0.20)	6,473 (3.28)	12,613 (17.57)	6,939 (20.20)	26,464 (5.02)	7.01
1991	457 (0.20)	6,625 (3.31)	13,106 (17.99)	7,113 (20.39)	27,301 (5.10)	7.13
1992	505 (0.22)	6,952 (3.40)	13,784 (18.51)	7,414 (20.79)	28,655 (5.24)	7.31
1993	560 (0.24)	7,402 (3.53)	14,606 (19.16)	7,815 (21.42)	30,383 (5.43)	7.57
1994	593 (0.24)	7,847 (3.67)	15,761 (20.27)	8,328 (22.39)	32,529 (5.70)	7.95
1995	584 (0.24)	8,159 (3.73)	16,402 (20.62)	8,717 (22.92)	33,862 (5.79)	8.10
1996	602 (0.24)	8,625 (3.88)	17,401 (21.50)	9,205 (23.78)	35,833 (6.03)	8.42
1997	598 (0.23)	9,303 (4.10)	18,183 (22.03)	9,848 (24.95)	37,932 (6.25)	8.74

Data are *n* (%) and are age-adjusted using 1980 U.S. population as the standard. *Age-adjusted percent.

IHS population) that had missing or incomplete data. For each fiscal year between 1 October 1990 and 30 September 1997, we used the IHS database to identify individuals with at least one diagnosis of diabetes, per the ninth revision of *International Classification of Diseases*, (Clinical Modification, codes 250.0–250.9). Unique patient identifiers were used to exclude duplicate records, and geographic location was determined according to the patient's community of residence.

To calculate prevalence of diabetes among Native Americans and Alaska Natives, we used the number of individuals identified with diagnosed diabetes in the IHS database and estimates of the population served by both IHS and tribal health facilities (i.e., the IHS service population). The IHS service population reflects the number of Native Americans and Alaska Natives who reside on reservations and in surrounding counties. Estimates of the IHS service population were projected from census, birth, and death data using linear regression techniques (7). The number of individuals with diagnosed diabetes and population estimates for those IHS units with missing or incomplete data were not included in the calculation of prevalence. Prevalence estimates were age-adjusted by the direct method using the 1980 U.S. population as the standard.

Because diabetes prevalence varies by tribe (5), we further examined trends by the following geographic areas: the Alaska region, the Atlantic region (Alabama, Connecticut, Florida, Indiana, Louisiana, Maine, Massachusetts, Mississippi, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, Tennessee, and Texas), the Great Lakes region (Michigan, Minnesota, and Wisconsin), the Northern Plains region (Iowa, Montana, Nebraska, North Dakota, South Dakota, and Wyoming), the Pacific region (California, Idaho, Oregon, and Washington); the Southern Plains region (Kansas and Oklahoma), and the Southwest region (Arizona, Colorado, Nevada, New Mexico, and Utah).

RESULTS — Between 1990 and 1997, the number of Native Americans and Alaska Natives with diagnosed diabetes increased from 43,262 to 64,474 individuals (Table 1). The prevalence of diagnosed diabetes (crude and age-adjusted) increased by 29%. By 1997, the prevalence among Native Americans and Alaska Natives was 5.4%; the age-adjusted prevalence was 8.0%.

The prevalence of diabetes increased with age. In 1997, prevalence ranged from 0.2% among those aged <20 years to 22.8% among those aged ≥65 years (Table 1). Between 1990 and 1997, prevalence increased among all age-groups: by 20% among those aged <20 years (0.17–0.20%), 29% among those aged 20–44 years (2.8–3.7%), 32% among those aged 45–64 years (15.2–20.1%), and 25% among those aged ≥65 years (18.2–22.8%).

Throughout the 1990–1997 period, the number of Native Americans and Alaska Natives with diabetes was greatest among individuals aged 45–64 years, followed by

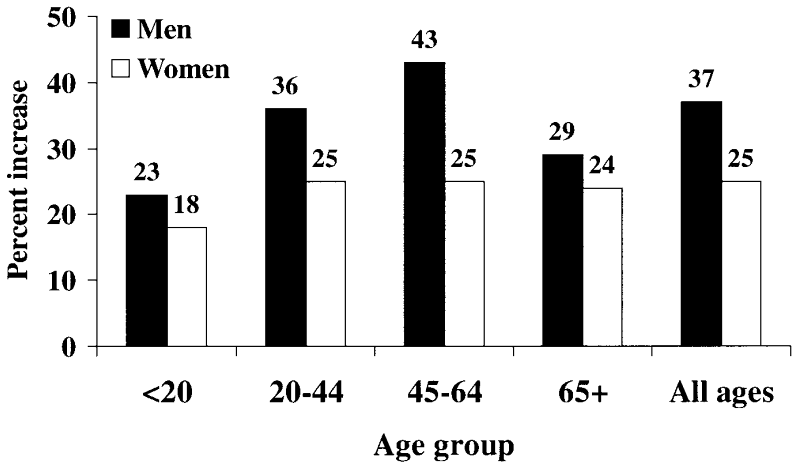

Figure 1—*Percent increase between 1990 and 1997 in the prevalence of diagnosed diabetes by age-group and sex among Native Americans and Alaska Natives.*

those aged 20–44 years, those aged ≥65 years, and those aged <20 years (Table 1). In 1997, individuals aged 45–64 years formed 49% (31,407 of 64,474) of the Native American and Alaskan diabetic population; those aged 20–44 years formed 25% (16,343 of 64,474), those aged ≥65 years formed 24% (15,673 of 64,474),and those aged <20 years formed 2% (1,051 of 64,474).

Between 1990 and 1997, the prevalence of diabetes and the number of diabetic cases were higher among Native American and Alaskan women than men (Table 1). In 1997, women were 1.4 times as likely to have diagnosed diabetes as men (6.3 vs. 4.5%). However, the prevalence between 1990 and 1997 increased at a greater rate among men than women (37 vs. 25%) (Fig. 1).

Prevalence of diabetes increased with age among both men and women (Table 1). Prevalence was higher among women than men in each age-group, but the relative increase in prevalence between 1990 and 1997 in each age-group was greater among men than women (Fig. 1). Among women, the percent increase in prevalence was similar across all age-groups and ranged from 18 to 25%. The percent increase among men increased through age 64 years and ranged from 23 to 43%.

The age-adjusted prevalence of diabetes varied by region, and in 1997, it ranged from 3.0% in the Alaska region to 17.4% in the Atlantic region (Fig. 2). Between 1990 and 1997, the age-adjusted prevalence increased in all regions and ranged from a 16% increase in the Northern Plains region to 76% in the Alaska region. Increases in the other regions—the Atlantic, Great Lakes, Pacific, Southern Plains, and Southwest regions—ranged from 28 to 37%. Although the Alaska region had the lowest age-adjusted prevalence of diabetes throughout the period, it had the highest relative increase in prevalence.

CONCLUSIONS — Diabetes prevalence is steadily increasing among Native Americans and Alaska Natives. In the short span of 8 years, prevalence increased by almost 30%; by 1997, diabetes affected the lives of nearly 65,000 Native Americans and Alaska Natives. The increase in prevalence was not caused by the aging of the population, because crude and age-adjusted prevalence increased equally. In contrast, age-adjusted prevalence of diabetes among the U.S. general population increased by 14% between 1990 and 1996 (6). Furthermore, the age-adjusted prevalence of diabetes among Native Americans and Alaska Natives adults is almost three times that of U.S. non-Hispanic whites (10). The increasing prevalence of diabetes among Native Americans and Alaska Natives further contributes to the already large and disproportionate burden of diabetes in this population.

Large increases in diabetes prevalence were seen across all Native American and Alaskan age-groups. Among those aged <45 years, the increase in prevalence (29%) was 10 times that of the same age-group in the U.S. general population (6). The increase among younger people poses a public health challenge for Native American and Alaskan communities, because younger individuals with diabetes will have more years of disease burden and a higher

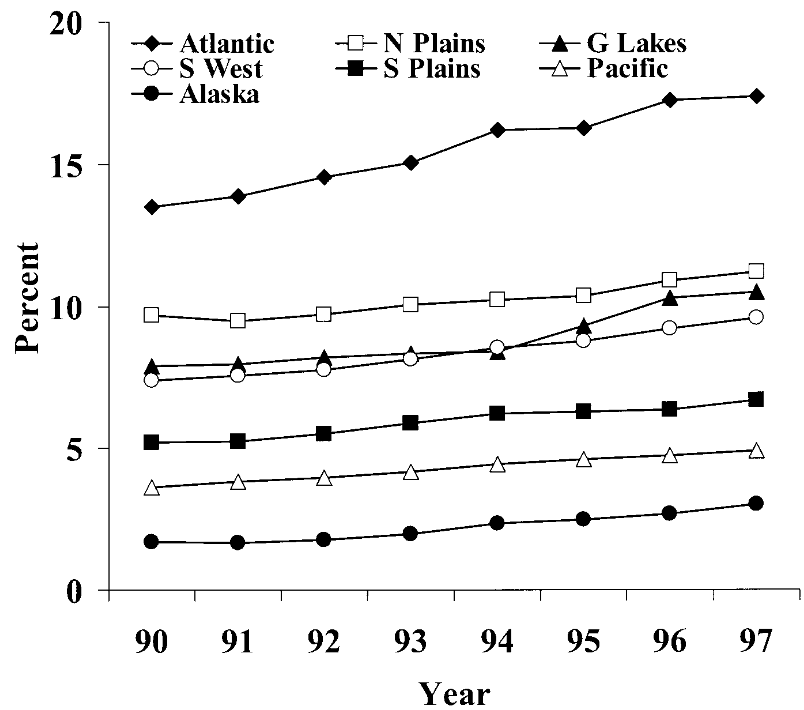

Figure 2—*Age-adjusted prevalence of diagnosed diabetes by region among Native Americans and Alaska Natives from 1990 to 1997.*

probability of developing diabetes-related complications earlier in life (5). Furthermore, the prevalence of diabetes among Pima Indian children increased with the increased frequency of exposure to diabetes in utero (11). Any increase in prevalence among the childbearing population may turn into a vicious cycle (i.e., diabetes during pregnancy would result in diabetes at a young age, which in turn would result in diabetes during pregnancy) that would be detrimental for future generations of Native Americans and Alaska Natives.

The Native American and Alaskan diabetic population is younger than the total U.S. diabetic population. Approximately 45% of the U.S. diabetic population is aged ≥65 years (6) compared with 24% of the Native American and Alaskan diabetic population. The greatest percentage of diabetic cases in the Native American and Alaskan diabetic population (49%) is among those aged 45–64 years. This Native American and Alaskan data is similar to data from developing countries in which the actual and predicted number of middle-aged individuals with diabetes is greater than the number of elderly individuals with diabetes (1). The implications of this data are similar to those previously discussed for those people aged <45 years; middle-aged Native Americans and Alaska Natives with diabetes will have more years of disease burden and a higher probability of developing diabetes-related complications at a younger age.

Consistent with previous findings (12,13), Native American and Alaskan women were more likely to have diagnosed diabetes than men. The higher prevalence among Native American and Alaskan women may be due to women seeking health care more frequently than men rather than a result of true differences in risk (7). Although Native American and Alaskan men had a lower prevalence than women, they had a higher relative increase in prevalence. The reason for the larger relative increase remains unclear.

Diabetes among Native Americans and Alaska Natives increased substantially in all regions. The largest relative increase was seen in the Alaska region, even though this region had the lowest age-adjusted prevalence of diabetes in 1990. The rapid growth in the Alaska region may signal the beginning of a diabetes epidemic among Alaska Natives.

Reasons for the increasing prevalence of diabetes among Native Americans and Alaska Natives cannot be determined from these cross-sectional data. Reasons may include increased incidence, better case ascertainment, or improved survival. Population-based studies that include regular screening for diabetes, such as those among the Pima Indians, indicate that the increase in prevalence may be because of a true increase in incidence (11). The risk of developing diabetes is associated with modifiable risk factors such as obesity, physical inactivity, and exposure to diabetes in utero (11,14). Prevalence of obesity, a major risk factor, has increased among Native Americans over the past decades (15,16). Moreover, low levels of physical activity, which are at least as prevalent among Native Americans as among the U.S. general population (17), are associated with obesity, glucose intolerance, and diabetes (18,19). Low levels of physical activity are also a problem among children. Pima Indian children, who are significantly heavier than Caucasian children by the age of 5 years, have physical activity levels much lower than those recommended by the World Health Organization (20). Increase in weight and frequency of exposure to diabetes in utero among Pima Indian children accounted for most of the increase in diabetes prevalence in this population in recent decades (11).

This analysis of trends in diabetes prevalence has several limitations. First, we were unable to account for individuals with undiagnosed diabetes. Studies estimate that, for every two individuals with diagnosed diabetes, one diabetic person is not diagnosed (12,13,21). Second, we lack data on diabetic Native Americans and Alaska Natives who did not visit IHS or tribal health facilities at least once during each of the years studied. Third, we are missing data on diabetic Native Americans and Alaska Natives who visited IHS or tribal health facilities that either did not report or incompletely reported their data to the IHS national outpatient database (16% of the population). Fourth, IHS service population estimates are based on U.S. census estimates and therefore may be inaccurate because census counts have underreported Native Americans and Alaska Natives in the past and do not account for migration between IHS or tribal health facilities (7). With the exception of those Native Americans and Alaska Natives aged 45–64 years, however, both IHS service population estimates of Native Americans and Alaska Natives and population estimates from health care utilization records increased at a comparable rate between 1990 and 1997 (7,9). Despite these limitations, previous research has shown that the IHS outpatient database and IHS service population estimates produce estimates of diabetes prevalence that closely agree with estimates from other Native American and Alaskan diabetes prevalence studies (3).

The prevalence of diagnosed diabetes among Native Americans and Alaska Natives served by IHS and tribal health facilities may not be representative of the total Native American and Alaskan population. We lack information on diabetes prevalence for ∼40% of the Native American and Alaskan population who do not reside on or near reservations and who do not receive care from IHS or tribal health facilities (7). Unfortunately, no comprehensive database is available to describe the health status of this segment of the Native American and Alaskan population. If this segment of the population has similar levels of risk factors for diabetes (e.g., obesity, physical inactivity, and genetic factors), then the prevalence of diabetes in this population is likely to be comparable with that of the Native American and Alaskan population served by IHS.

Native Americans and Alaska Natives of all ages suffer from a disproportionate burden of diabetes, and this burden appears to be increasing substantially. Unfortunately, diabetes will likely continue to increase as the Native American and Alaskan population ages and as the prevalence of risk factors increases. Therefore, effective interventions for primary, secondary, and tertiary prevention are needed. Secondary prevention interventions to aggressively control blood glucose levels may prevent or delay diabetes-related complications, such as retinopathy, nephropathy, or neuropathy (22,23). In addition, tertiary prevention interventions, such as screening for diabetic eye and foot disease, can reduce the incidence of blindness and amputation (24,25). Among individuals at risk for developing type 2 diabetes, primary prevention interventions that promote healthy behaviors (e.g., increasing exercise, improving nutrition, or reducing body weight) may prevent or delay the onset of diabetes (26).

Primary prevention interventions are needed in Native American and Alaskan communities, especially among younger individuals. Some Native American communities have developed such school programs as the Pathways and Quest programs to increase physical activity, improve diet, and reduce obesity among children (27,28). These programs may serve as examples to other communities whose younger people are at risk of developing diabetes. As research findings emerge from ongoing diabetes primary prevention trials, rapid translation of successful strategies is an urgent priority for the IHS. Continued surveillance of diabetes using the IHS outpatient database will be an important tool in monitoring the effectiveness of these strategies.

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