Declining Mortality Rate Among People With Diabetes in North Dakota, 1997–2002

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Both the increasing prevalence (1,2) and the high lifetime risk for diabetes (3) have enormous implications for the future; this disease is a major cause of premature mortality, and people with diabetes die at about twice the rate of people without diabetes (4). Efforts to track mortality trends have been difficult because death certificates, as currently structured, are inadequate to assess diabetes mortality, as less than half of diabetic decedents have diabetes listed (4). To improve the tracking of mortality among people with diabetes, North Dakota added a check box to its death certificate in 1992 that asked whether the decedent had diabetes. The period of 1992–1996 has been reported previously (5). In this study, we use the check box to aid in calculating the number of decedents with diabetes and in examining mortality rates among those with diabetes from 1997 through 2002.

RESEARCH DESIGN AND METHODS

— We used 1997–2002 North Dakota death certificate data to calculate the number of deaths among individuals with diabetes. A decedent was considered to have diabetes if the underlying cause of death or the contributing causes of death had an ICD-9 or -10 code for diabetes (ICD-9 code 250 in 1997 or 1998; ICD-10 codes E10–E14 in 1999–2002) or if the diabetes check box (responses: yes or no) indicated that the decedent had diabetes. Multiple imputation (6) was used to adjust for missing values on the check box (range 20–24% missing per year). We used PROC MI (Multiple Imputation Procedure in SAS, version 8) (7) to build a linear regression model using age, race, sex, year of death, and cause of death to produce five multiple imputed datasets and averaged the estimates from these five datasets to assess diabetes status on those with a missing check box. We used data from the 1997–2002 North Dakota Behavioral Risk Factor Surveillance System (BRFSS) to obtain the number of individuals with diabetes in North Dakota. People were considered to have diabetes if they responded yes to the question: "Have you ever been told by a doctor that you have diabetes?" Women who responded that this was only during pregnancy were considered not to have diabetes. Mortality rates were estimated as the number of deaths with diabetes divided by the number of people with diabetes. In SAS, we used linear regression weighted to the inverse of the variance of the mortality rate to obtain annual predicted mortality rates and assess trends (slope different from 0) in these predicted rates (8). We modeled unadjusted rates and rates adjusted to the 2000 U.S. standard population using two age-groups: 18–64 and 65+. In our model, the actual rate was the dependent variable and the year was the independent variable.

RESULTS

— The percentage of decedents with diabetes in North Dakota increased over the study period from 21.3% (n = 1,225) of all deaths in 1997 to 24% (n = 1,391) of all deaths in 2002. The prevalence of diagnosed diabetes also increased from 3.5% (n = 16,538) in 1997 to 6.2% (n = 29,274) in 2002. Compared with the rate in 1997, the overall mortality rate in 2002 deceased 35% among individuals with diabetes (from 74.1 to 47.5 of 1,000) (Fig. 1).

Results from the linear regression showed that the yearly decline in the unadjusted mortality rate was 4.0 deaths per 1,000 (P = 0.03, R^2 = 0.73) among people with diabetes (Fig. 1). The results by sex were similar to the overall yearly average decline, although they were not significant for men (data not shown). Small samples of people with diabetes precluded us from assessing trends by age. Results from the linear regression showed that the yearly decline in the adjusted mortality rate was 2.0 deaths per 1,000 (P = 0.07, R^2 = 0.60) among people with diabetes (Fig. 1). The results by sex were similar to the overall yearly average decline, although they were not significant for men (data not shown).

CONCLUSIONS

— The diabetes check box on North Dakota death certificates allowed us to determine whether decedents had diabetes and thus track trends in mortality among people with this disease. Age adjusting resulted in a smaller decline that was not significant. This could be due to the fact that there was indeed no decline or because our age-specific rates were not stable. We believe that the latter is the case.

Similar to our study, a population-based study in Rochester, Minnesota, showed a decline in diabetes mortality rates between 1970 and 1994. The decline was much less (13.8 vs. 35.9%) (9), but it was for an earlier time period. In contrast to our study, another study that used a national sample reported nonsignificant changes in diabetes mortality

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A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

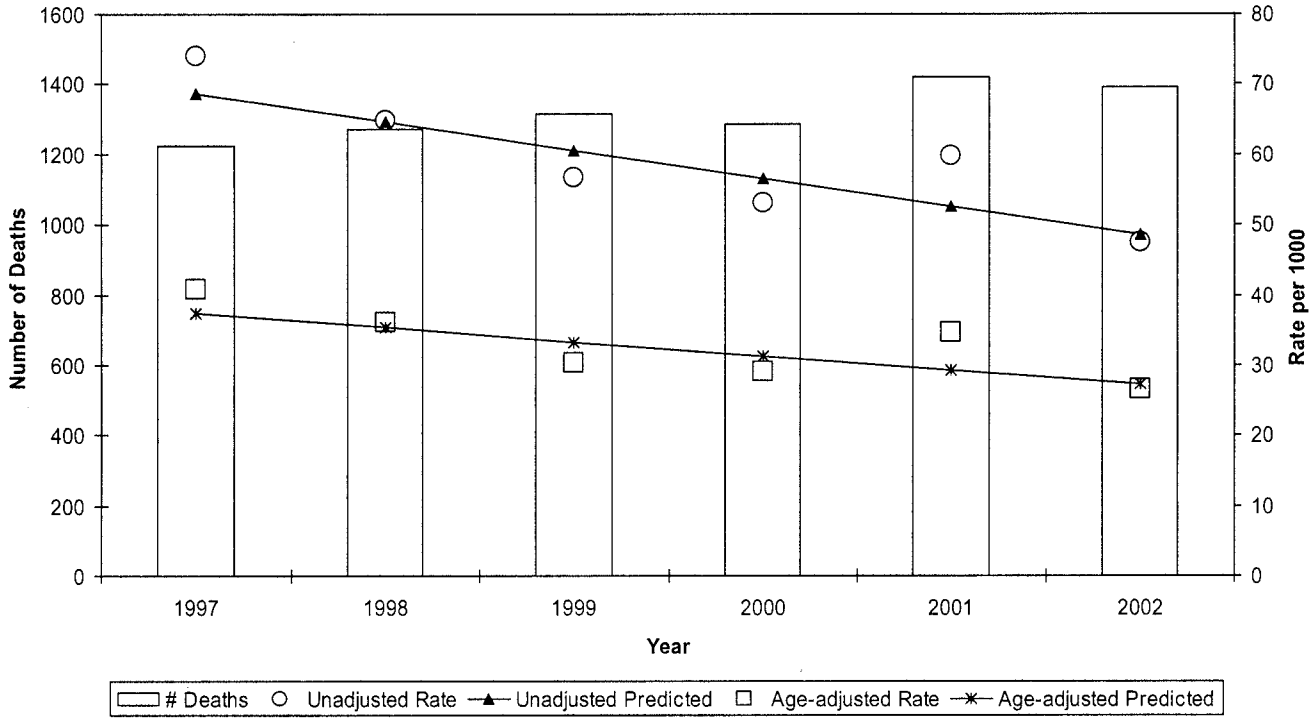

Figure 1—*Number of deaths, unadjusted and age-adjusted death rate, and predicted death rate among people with diabetes in North Dakota, 1997–2002.*

rates (10). The time frame of this latter study (cohorts for 1971–1975 and 1982–1984), however, was much earlier than ours.

There could be several reasons for the decline in the mortality rate among people with diabetes in North Dakota. For example, it could be due to improvements in the care that people with diabetes received, such as an increase in the proportion of individuals with diabetes who received preventive care practices. In both North Dakota and the U.S. as a whole, there have been recent improvements in rates of A1c testing, self-monitoring of blood glucose, seeing a health care professional for diabetes, receiving a dilated eye exam or foot exam, and receiving pneumococcal and influenza vaccination (11). The decline in mortality may also be due to factors we were unable to assess, including increases in aspirin therapy or improvements in blood pressure, cholesterol, and glucose control (12). We were unable to control for the duration of diabetes, and the large recent increases in the number of people with diabetes could result in an increase in the number of people with a shorter duration who have less severe disease. However, the duration of diabetes in a national survey has recently been stable (11).

Mortality trends are an important long-term indicator of the public health impact of diabetes. As efforts continue to try to stem the rising epidemic of diabetes, tracking trends in mortality will become increasingly important because more than one in three people in the U.S. are expected to develop diabetes in their lifetime (3). Unless efforts are successful to reduce the excess mortality due to diabetes, those who develop the disease will face the risk of reduced quality and length of life. Public health officials in North Dakota will need to continue to monitor trends in the mortality of people with diabetes to assess whether the declines in mortality seen in this study represent a real and continuing trend.

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