Diabetes Mortality In Rhode Island:
Comparing Underlying Cause of Death versus Any Listed Cause of Death

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In 2005, an estimated 20.8 million people in the United States had diabetes and nearly 30% of these cases were undiagnosed.[1] The age-adjusted mortality of individuals with diabetes is approximately twice that of non-diabetic individuals.[2] In 2005, diabetes was listed as the sixth leading cause of death in the United States.[3] National cause of death statistics have historically been based on the underlying cause of death listed on the death certificate, where the underlying cause is defined as "the disease or injury that initiated the train of events leading directly to death." This method of reporting mortality statistics does not account for other conditions mentioned on the death certificate described as "the disease or condition contributing but not leading directly to death."[4] Studies have found that only 30 to 40 % of decedents with diabetes have diabetes listed anywhere on the death certificate[5-7] and only about 10 to 15% had it listed as the underlying cause of death.[5,8]

Diabetes is a well-established risk factor for the development of serious complications, such as cardiovascular disease, which may ultimately be coded as the underlying cause of death; consequently, reporting only underlying cause of death data may substantially underestimate the death burden of diabetes. Using any listed cause of death, defined as the disease or condition mentioned as underlying or attributing cause of death, reported on death certificates may more appropriately capture mortality attributable to diabetes. This report compares the number and rates of deaths in Rhode Island with diabetes coded as the underlying cause of death versus deaths coded with diabetes as any listed cause of death.

METHODS

The Office of Vital Records of the Rhode Island Department of Health provided an analytic file of death certificate data for state residents from 1995 through 2005 for this study. Diabetes was coded as the underlying cause of death if it was listed as such on the death certificate. Diabetes was coded as any listed cause if diabetes was mentioned on the death certificate as either the underlying or a contributing cause of death.

Numbers and rates of deaths with diabetes coded as the underlying cause and as any listed cause were compared based on age, gender, race, and Hispanic origin. (Race and Hispanic origin data were available in comparable format only for the years 2003-2005). Denominators were obtained from the 2000 US census data; for analyses by demographic characteristics, the Census denominators were adjusted to produce estimates of the number of diabetics through weighting with three-year age-, race-, and sex- specific average prevalence rates for diabetes from the Rhode Island **Behavioral Risk Factor Surveillance System (BRFSS)**. Death rates were age adjusted to the 2000 United States Standard Population using age groups 0-44, 45-64 and 65+. For each rate, the 95% **confidence interval (CI)** was calculated in order to test for statistically significant differences between the two types of rates and between groups.

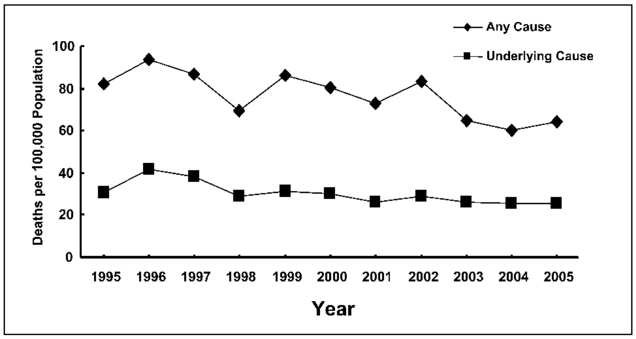

Figure 1: Age-adjusted diabetes mortality rates per 100,000 population, Rhode Island, 1995-2005.

RESULTS

From 1995 to 2005, 2,657 diabetes deaths were identified with diabetes mentioned as underlying cause of death and 7,360 diabetes deaths were identified with diabetes mentioned as any listed cause of death. The average age-adjusted diabetes death rate per 100,000 Rhode Island residents was 30.2 (95% CI: 28.3-32.1) for diabetes mentioned as underlying cause and 76.8 (95% CI: 74.3-79.3) for diabetes mentioned as any listed cause of death. (Table 1) Between 1995 and 2005, the annual mortality rate in Rhode Island from diabetes as the underlying cause of death decreased slightly; the annual mortality rate from diabetes as any listed cause of death declined variably over time. (Figure 1)

Over the eleven-year period 1995 to 2005, older age group was positively correlated with mortality, with individuals aged 18-44 having the lowest mortality rates per 10,000 diabetics and individuals aged 65+ having the highest rates, regardless of diabetes cause of death coding. (Figure 2. Death rates for the age group 0-17 are not presented due to small numbers.) By gender, the average age-adjusted mortality rate was slightly higher for both underlying and any listed cause for

Table 1: Average Annual Age-Adjusted* Death Rate for Diabetes as Underlying Cause of Death and as Any Listed Cause of Death, Rhode Island, 1995-2005.

Diabetes Cause of Death Code	Death Rate per 100,000	95% Confidence Interval
Underlying	30.19	28.27, 32.12
Any Listed	76.80	74.31, 79.28

*Age-adjusted to 2000 US standard population

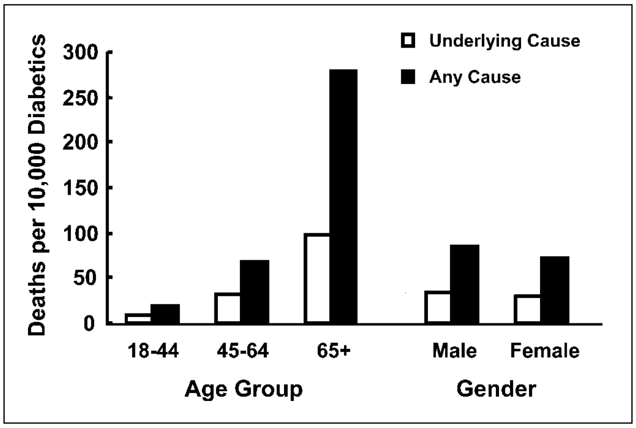

Figure 2. Average annual diabetes mortality rates per 10,000 diabetic population, by age group and gender (age-adjusted), Rhode Island, 1995-2005.

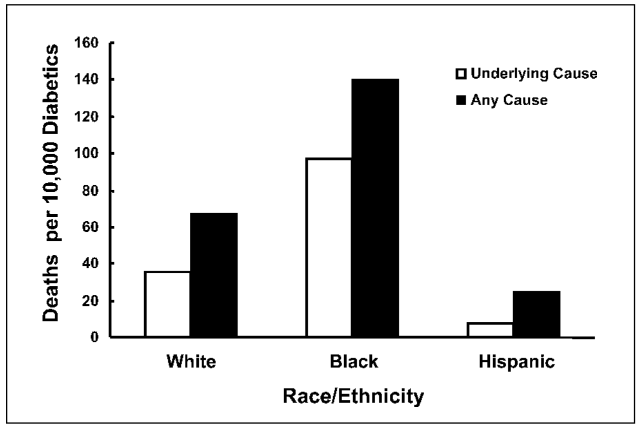

Figure 3. Average annual age-adjusted diabetes mortality rates per 10,000 diabetic population, by race and ethnicity, Rhode Island, 2003-2005.

males (33.0 and 84.4, respectively) than for females (28.9 and 71.5, respectively), with any listed cause greater for both genders. (Figure 2) With respect to race, from 2003 to 2005, Black diabetics had the highest average annual age-adjusted mortality rate from diabetes, while rates for White and Hispanic diabetics were substantially lower. Using underlying cause of death underestimated diabetes deaths in all races, most notably in Hispanics, in which about 3.5 times more diabetes deaths were captured with diabetes coded as any listed cause of death than with diabetes as the underlying cause of death. (Figure 3)

Discussion

This report indicates that use of underlying cause of death data leads to substantial underreporting of mortality in Rhode Island related to diabetes. About 2.5 times more diabetes deaths were captured with diabetes mentioned as any listed cause of death than with diabetes listed as the underlying cause of death. This finding is consistent with numbers reported elsewhere.[5-8]

As expected, since chronic disease mortality increases with age, diabetic residents aged 65+ had the highest rates of diabetes deaths compared to diabetics in other age groups. Among all age groups, classifying diabetes deaths only by underlying cause underestimated death rates, most notably in the 65+ age group. The average annual mortality rate for diabetes was slightly higher for males with diabetes than for females for both any and underlying cause. Reporting based only on underlying cause of death underestimated diabetes deaths similarly in both genders.

From 2003 to 2005, Blacks had the highest average annual mortality rate from diabetes mentioned as the underlying or any listed cause of death, whites had the second highest rate, and mortality rates from diabetes among Hispanics were lowest. Underlying cause of death underestimated diabetes deaths in all races, most notably in Hispanics, in which about 3.5 times more diabetes deaths were captured with diabetes coded as any listed cause of death than underlying cause of death. (Figure 4)

Including deaths where diabetes is identified as a contributing cause increases the number of diabetes–related deaths in Rhode Island during 1995-2005 by 4,703, or an average of 428 deaths per year, an increase of 177% relative to the number of deaths with diabetes identified as the underlying cause. These deaths occur among all demographic groups based on age, gender, race and ethnicity. These findings strongly support the conclusion that reporting diabetes mortality statistics with diabetes mentioned as any listed cause rather than based on underlying cause of death would more accurately and appropriately illustrate the extent of diabetes death burden in Rhode Island.

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Disclosure of Financial Interests

The authors have no financial interests to disclose.