

Improving the comparability of diabetes mortality statistics in the United States and Mexico

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ABSTRACT

Objective: To increase the cross-state comparability of diabetes mortality statistics related in the US and Mexico.

Methods: We used multinomial logistic regression to estimate the effects of individual and community factors on a death for which diabetes was recorded as one of the multiple contributing causes of death (MCD) being assigned to diabetes as the underlying cause of death (UCD), versus to cardiovascular, other non-communicable, or communicable diseases. We used the model to estimate state-level diabetes death rates that are standardized in the individual and community factors.

Results: Deaths with diabetes as one of the multiple causes of death were more likely to be assigned to cardiovascular causes if they occurred in hospitals or had a necropsy, and if the decedents were from states with higher BMI and SBP, more educated, or insured. Adjusting for individual- and community-level factors substantially increased the cross-state correlation of diabetes UCD and diabetes MCD mortality rates. The adjustment also reduced the number of direct diabetes deaths by 10% in the USA and by 24% in Mexico. In the US, UCD diabetes deaths declined most in Utah, New Mexico, New Jersey and Louisiana, and increased in California and Hawaii. In Mexico, adjusted diabetes deaths were smaller than observed ones in all states by 3-34%. An additional 126,300 IHD and stroke deaths in the US and 19,497 in Mexico were attributable to high blood glucose.

Conclusions: There is a need to improve the comparability of diabetes cause of death assignment, especially in relation to cardiovascular diseases.

The validity and comparability of cause of death statistics may be affected at the time of medical certification and, in countries without automated coding, in the process of assignment of an International Classification of Diseases (ICD) code for the underlying cause of death. The validity and comparability of cause of death data related to diabetes can be affected in two ways: First, a number of studies have found that diabetes appears as one of the multiple contributing causes of death (MCD) on two thirds or less of the death certificates of people with known diabetes(1-7). Second, even when diabetes appears as one of the MCDs, the ordering of causes on the death certificate can affect whether diabetes is registered as the UCD in subsequent coding, and hence affect comparability (8-10). Lack of comparability in diabetes UCD statistics occurs partly because diabetics have an increased risk of mortality from other diseases, especially cardiovascular diseases (11; 12); it has been found that cardiovascular diseases may be the most common underlying cause of death among people with diabetes (3; 13). Different certifiers may record diabetes or cardiovascular diseases on the death certificate, or change the order of recorded causes. This specific obstacle to comparability has received substantially less attention than under-recording of diabetes on the death certificate.

We used individual death records to examine the cross-state comparability of diabetes cause of death statistics in the US and Mexico. We analyzed the effects of individual- and community-level factors on cause of death assignment across states in these two countries. We used the results to estimate diabetes death rates by state that are standardized in the levels of individual- and

community-level determinants of cause of death assignment, to increase the comparability of diabetes mortality statistics.

METHODS

Data Sources. Data for causes of death were the NCHS National Vital Statistics System in the US and from *Secretaría de Salud* in Mexico. Both sources maintain records for all deaths in the country, including multiple causes of death and standard socio-demographic characteristics. All deaths coded to Diabetes Mellitus in the MCD dataset between 1999 and 2001 in the US (640,543 deaths), and between 2004 and 2005 in Mexico (182,796 deaths) were included in the analysis to maximize predictive power. Analysis was limited to deaths above the age of 20 years because very few diabetes deaths occur at younger ages. Deaths for which injuries were the UCD were excluded from the analysis because they were assumed to be correctly assigned.

Statistical model. We used multinomial logistic regression to estimate the relative risk ratios (RRR) of a death, for which diabetes was recorded as an MCD, being assigned to diabetes versus to cardiovascular diseases, other non-communicable diseases, or communicable diseases as the UCD. The multinomial logistic regression estimates the RRRs for observing a dependent variable with more than two outcome categories as a function of independent covariates; the statistical basis and applications to epidemiological data are described elsewhere (14; 15). RRRs were estimated for assignment to each of the disease clusters *relative to assignment to diabetes*. The independent variables in the regression were exogenous individual- and community-level variables listed in Table 1.

We used the coefficients of the multinomial logistic regression to predict the probabilities that each death would be assigned to each of these four disease clusters if the individual and community characteristics were those of a fixed reference category, as defined in Table 1. Although any fixed category could be used for the purpose of comparability, the reference category in Table 1 is one that is expected to represent the highest access to specialized healthcare, and hence the greatest likelihood of valid cause of death assignment, above and beyond comparability. We controlled for age to avoid confounding effects of factors that may also be associated with age. However, we did not use a reference age category in the adjusted (predicted) probabilities because some causes of death are expected to have true age patterns, which should be preserved. For the same reason, we adjusted the regressions for body mass index (BMI) and systolic blood pressure (SBP) but did not standardize these variables in the prediction stage to retain true epidemiological differences. Predicted probabilities were aggregated by sex, age groups, and state to produce comparable estimates of diabetes deaths, and those of other disease clusters for each state.

All analyses were conducted separately for the US and Mexico, to account for potential differences in the case-fatality of diabetes patients in the two countries.

RESULTS

Observed cause of death statistics (national and state patterns). Excluding deaths from injuries, diabetes and cardiovascular diseases, respectively, comprised 33% and 39% of underlying causes of death among the universe of deaths with diabetes as one of the MCD in the US, and 67% and 14% in Mexico (Figures 1a and 1b). Cancers (10%

in the US and 6% in Mexico) and a number of other non-communicable diseases accounted for the remaining proportion, except for a small proportion of deaths assigned to communicable diseases (4% in the US and 3% in Mexico). Nearly 3% and 14% of all deaths in the US and Mexico, respectively, are currently assigned to diabetes; 38% and 23% are assigned to cardiovascular diseases.

In both countries there were large discrepancies at the state level between the rates of diabetes as UCD and the rates of deaths for which diabetes appears as one of the MCDs on the death certificate (Figure 2a). For example, in 2001, age-standardized (using 2000 US population ≥ 20 years) diabetes MCD death rates in Hawaii, Utah, and Louisiana were between 10.0 and 10.7 per 10,000 but age-standardized diabetes UCD death rates varied by a factor of more than three (1.8 in Hawaii, 4.4 in Utah, and 5.8 in Louisiana). Similarly, Baja California Sur and Guanajuato had age-standardized (using 2000 Mexico population ≥ 20 years) diabetes MCD death rates of 16.0 and 16.6 per 10,000 but age-standardized diabetes UCD death rates varied by a factor of 1.6 (8.0 in BCS and 13.0 in Guanajuato).

Regression analysis. In-hospital deaths, for which more clinical information may be available, had substantially higher probabilities than out-of-hospital deaths of being assigned to cardiovascular diseases (RRR = 1.16 in the US and 1.87 in Mexico) (Table 2). In-hospital deaths also had a higher probability of assignment to communicable diseases (RRR = 2.89 in the US and 2.84 in Mexico), possibly due to sepsis deaths. Assignment to other non-communicable diseases was less likely for in-hospital deaths relative to out-of-hospital deaths (RRR = 0.91) in the US, and more likely (RRR = 1.42) in Mexico.

In the US, the number of cardiologists was inversely associated with assignment to cardiovascular, other non-communicable and communicable diseases, with a 4%, 4%, and 6% reduction in the probability relative to assignment to diabetes for each additional cardiologist per 100,000 residents, respectively. The probabilities of being assigned to cardiovascular, other non-communicable and communicable diseases relative to diabetes increased with additional number of endocrinologist and nephrologists (only some of these results were significant). These results may reflect actual or perceived diabetes treatment, or additional medical knowledge used in certification, with higher specialized diabetes care.

In the US, compared to white men, almost all other race-ethnicity-sex groups had lower probabilities of being assigned to cardiovascular and other non-communicable causes relative to diabetes. The sex pattern was reversed in Mexico. Decedents with below-high-school education had a smaller likelihood of being assigned to cardiovascular diseases and other non-communicable diseases in both the US and Mexico compared to individuals that achieved college or more. There was a higher probability of being assigned to cardiovascular diseases (RRR = 1.19) and other non-communicable (RRR = 1.27) and lower to communicable (RRR = 0.77) if individuals were insured. These findings may all demonstrate differential treatment of diabetes and/or differential availability of information at the time of certification.

The probability of the death of a confirmed diabetic decedent being assigned to cardiovascular disease, relative to diabetes, increased with state BMI and SBP (RRR = 1.03 and RRR = 1.01 for each unit change in BMI and SBP, respectively, in the US; RRR = 1.20 and RRR = 1.01, respectively, in

Mexico). This finding likely represents a true epidemiological pattern, in which, among those with confirmed diabetes, living in a population with higher BMI and SBP reflects an increased risk of cardiovascular mortality. For deaths assigned to other non-communicable and communicable diseases, the probability increased with higher BMI in both countries, possibly because of the effects of BMI on non-communicable diseases as well as general health status. There were no clear effects for SBP for non-cardiovascular causes.

Adjusted cause of death statistics (national and state patterns). After standardizing for the effects of individual- and community-level determinants, the relationship between diabetes UCD and diabetes MCD mortality across states was substantially strengthened in both the US and Mexico (Figure 2b). In the US, UCD diabetes deaths declined most in Utah, New Mexico, New Jersey and Louisiana, with the adjusted rates 32%-45% lower than the observed rates. The largest increase in diabetes death rates occurred in Hawaii and California, with a 64% and 17% increase in diabetes death rate after adjustment respectively. In Mexico, adjusted UCD diabetes death rates were smaller than observed ones in all states, with the largest decreases in Guanajuato, Tabasco, and Puebla (34% for each), and the smallest decreases in Baja California Sur (3%) and Nuevo León (12%).

After standardizing the individual- and community-level determinants to the reference values in Table 1, of the universe of deaths with diabetes as an MCD, the number of deaths with diabetes as the UCD declined from 71,276 (33% of diabetes MCD deaths) to 63,874 (30%) in the USA (2001), and from 63,607 (67% of diabetes MCD deaths) to 48,318 (51%) in Mexico (2005) (Table 3). Cardiovascular diseases

increased from 85,134 (39% of diabetes MCD deaths) to 98,583 (46%) in the US, and from 13,070 (14% of diabetes MCD deaths) to 22,539 (24%) in Mexico. There was also an increase for communicable diseases in both countries but the change for other non-communicable diseases was in opposite direction for the two countries.

In addition to these direct diabetes deaths, high blood glucose increases the risk of mortality from cardiovascular outcomes. Using data on blood glucose from the nationally-representative National Health and Nutrition Examination Survey (NHANES) 1999-2002 in the US and Encuesta Nacional de Salud (National Health Survey, ENSA) 2000 in Mexico, and using methods described in detail elsewhere (16), an estimated 106,543 IHD deaths (21% of all IHD deaths) and 19,757 stroke deaths (12% of all stroke deaths) were attributable to higher-than-optimal blood glucose in the US, and 14,224 IHD deaths (26%) and 5,273 stroke deaths (19%) in Mexico.

DISCUSSION

Definitive identification of incomparable coding between diabetes and other diseases among diabetic patients requires detailed prospective studies, with standardized cause-of-death certification. In this analysis, we retrospectively investigated some of the individual and community determinants of cause of death assignment with the aim of enhancing the cross-state comparability of diabetes death rates in the US and Mexico.

Standardizing the assignment of diabetes deaths in this analysis to a reference level of individual and community determinants led to significant changes in the diabetes pattern across states and race-sex groups and improved the cross-state comparability of the diabetes cause of death statistics. In addition to improved comparability, the

reference level of individual and community determinants used in this analysis is one that is expected to provide the most valid cause of death statistics; standardizing to this reference level led to reduction in the number of deaths assigned directly to diabetes in both the US and Mexico .

This study is affected by a number of limitations. Whether a death occurred in hospital, the number of specialized doctors per capita, and the autopsy variable were valuable proxies for clinical information and diagnostic skills at the community level. Better information on training and diagnostic facilities of the hospitals in which individuals died would allow a more direct assessment of these factors. The death certificate itself may contain errors (e.g. educational attainment and race, which are provided by next of kin). The finding on the role of race, ethnicity, and sex may reflect differences in quality of care experienced by minority patients (17) and differential practices in cause of death assignment, or actual epidemiological differences in the natural history of diabetes. Finally, our analysis focused on comparability across states in the same country, which limits its application to cross-country comparability.

Above and beyond comparability, improving the overall validity of death certificates is important for public health planning. Improving validity and comparability requires better training in cause of death certification, accessible information on medical history (e.g. through linked records), and standardized (and ideally automated) coding. Together with such national efforts, the new revision of the International Classification of Disease should provide further clarity on the assignment of the underlying cause of death as related to diabetes and cardiovascular diseases.

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TABLE 1. Model variables, descriptions, and data sources.

Independent variable	Values	Data sources		Reference value for adjusted estimates	Reasons for inclusion in analysis
		US ^a	Mexico ^a		
Sex	Male, female	Death record	Death record	Male	Indicators of socioeconomic determinants of access, utilization, and quality of care
Race and Hispanic ethnicity ^b	White NH males, white NH females, black NH males, black NH females, Hispanic males, Hispanic females, other NH males, other NH Females	Death record	NA	White NH Males	
Insurance Status	Insured / not insured	NA	Death record	Insured	
Educational Level	Less than high school, less than college, college or post-graduate	Death record	Death record	College-educated	
Place of death	In-hospital (defined as hospital or healthcare facility), out-of-hospital	Death record	Death record	In-hospital	Indicator of a more complete medical history before/at the time of death
Age	5-year intervals from 20 to 85+	Death record	Death record	Decedent's actual age	Incorporating the true age patterns of diabetes and other causes of death
Systolic blood pressure (SBP)	Mean SBP by sex, 5-year age groups, and state of residency	BRFSS ^c corrected for bias in self-reported hypertension status based on NHANES ^c	ENSANUT 2005-6 ^c	Actual SBP of the decedent's state, age group and sex	Risk factors for diabetes and/or cardiovascular deaths; community level data were used because death certificate does not include these data for individuals.
Body mass index (BMI)	Mean BMI by sex, 5-year age groups, and state of residency	BRFSS ^c corrected for bias in self-reported weight and height based on NHANES ^c (18)	ENSA 2000 ^c	Actual BMI of the decedent's state, age group and sex	
Necropsy	Necropsy performed, not performed	NA	Death record	Performed	Indicators of specialized medical knowledge used in assigning causes of death.
Cardiologists, Endocrinologists, Nephrologists	County-level estimate of cardiologists, endocrinologists and nephrologists per 100,000 residents; ranges (1.9-12.7), (0.1-4.3), and (0.1-3.7), respectively	Dartmouth Atlas of Health Care ^d	NA	80 th percentile of all national counties (7.6 per 100,000) (1.3 per 100,000) (1.8 per 100,000)	

^a NA refers to those variables for which data in one country were not available and not included in analysis for that country.

^b NH refers to non-Hispanic.

^c BRFSS: Behavioral Risk Factor Surveillance System; NHANES: National Health and Nutrition Examination Survey; ENSA: Encuesta Nacional de Salud (National Health Survey); ENSANUT: Encuesta Nacional de Salud y Nutricion (National Health and Nutritional Survey)

^d The Dartmouth Atlas of Health Care (year 1999) (<http://www.dartmouthatlas.org>) provides estimates for Hospital Referral Region, which are linked to zip codes, which can in turn be mapped to county codes. Because zip codes do not map exactly to county boundaries, counties that did not have a value for cardiologists were assigned the same value as the adjacent county with the closest per capita income.

TABLE 2. Relative risk ratios (RRRs), p-values, and confidence intervals for the multinomial logistic regression. For each outcome and for each independent variable, RRR measures the probability of death being assigned to that disease category relative to diabetes, and relative to the same probability if the independent variable were set to its reference value which has an RRR of 1.0 (see reference (14) for details).

United States									
	Cardiovascular diseases ^a			Other non-communicable ^b			Communicable ^c		
	RRR	p	95% CI	RRR	p	95% CI	RRR	p	95% CI
<i>Race-sex</i>									
White NH males	1.00			1.00			1.00		
White NH females	0.78	<0.001	0.76-0.80	1.04	0.008	1.01-1.07	1.02	0.394	0.97-1.08
Black NH males	0.83	<0.001	0.81-0.86	0.83	<0.001	0.81-0.85	1.15	<0.001	1.09-1.22
Black NH females	0.66	<0.001	0.64-0.68	0.79	<0.001	0.76-0.81	0.89	0.001	0.84-0.95
Hispanic males	0.79	<0.001	0.76-0.81	0.79	<0.001	0.76-0.82	1.05	0.253	0.97-1.13
Hispanic Females	0.59	<0.001	0.57-0.61	0.78	<0.001	0.75-0.82	0.86	0.001	0.79-0.94
Other NH males	1.01	0.605	0.96-1.07	0.91	0.004	0.86-0.97	1.27	<0.001	1.13-1.42
Other NH females	0.73	<0.001	0.69-0.77	0.87	<0.001	0.81-0.92	1.16	0.017	1.03-1.30
Place of Death (in hospital)	1.16	<0.001	1.14-1.17	0.91	<0.001	0.90-0.92	2.89	<0.001	2.80-2.98
<i>Educational Level</i>									
Below high school	0.94	<0.001	0.93-0.96	0.95	<0.001	0.93-0.97	0.97	0.232	0.93-1.02
Below college	1.00	0.886	0.98-1.01	1.01	0.357	0.99-1.03	1.00	0.858	0.97-1.04
College or more	1.00			1.00			1.00		
<i>Age (years)</i>									
20-24	0.17	<0.001	0.13-0.24	0.30	<0.001	0.23-0.37	0.80	0.334	0.51-1.25
25-29	0.22	<0.001	0.18-0.27	0.27	<0.001	0.22-0.32	1.07	0.653	0.79-1.45
30-34	0.39	<0.001	0.35-0.44	0.30	<0.001	0.26-0.34	1.12	0.328	0.89-1.40
35-39	0.51	<0.001	0.47-0.56	0.30	<0.001	0.27-0.33	1.26	0.01	1.06-1.50
40-44	0.66	<0.001	0.62-0.71	0.39	<0.001	0.36-0.42	1.44	<0.001	1.25-1.65
45-49	0.76	<0.001	0.72-0.80	0.46	<0.001	0.44-0.49	1.29	<0.001	1.15-1.45
50-54	0.93	0.001	0.89-0.97	0.56	<0.001	0.53-0.59	1.10	0.059	1.00-1.23
55-59	0.98	0.272	0.95-1.02	0.70	<0.001	0.67-0.73	1.03	0.526	0.94-1.12
60-64	1.00	0.862	0.97-1.03	0.85	<0.001	0.82-0.88	0.96	0.352	0.89-1.04
65-69	1.00			1.00			1.00		
70-74	1.05	<0.001	1.03-1.08	1.10	<0.001	1.07-1.13	1.20	<0.001	1.13-1.27
75-79	1.04	0.01	1.01-1.08	1.31	<0.001	1.26-1.36	1.33	<0.001	1.23-1.44
80-84	1.11	<0.001	1.07-1.15	1.25	<0.001	1.20-1.30	1.62	<0.001	1.49-1.76
85+	1.15	<0.001	1.11-1.19	1.13	<0.001	1.09-1.18	2.14	<0.001	1.97-2.32
SBP	1.01	<0.001	1.01-1.01	0.98	<0.001	0.98-0.98	1.00	0.559	0.99-1.00
BMI	1.03	<0.001	1.02-1.03	1.02	<0.001	1.01-1.03	1.02	0.002	1.01-1.04
Cardiologists	0.96	<0.001	0.95-0.96	0.96	<0.001	0.95-0.96	0.94	<0.001	0.93-0.95
Endocrinologists	1.03	0.001	1.01-1.05	1.05	<0.001	1.03-1.07	1.13	<0.001	1.08-1.18
Nephrologists	1.07	<0.001	1.05-1.08	1.01	0.284	0.99-1.03	1.19	<0.001	1.14-1.23
Mexico									

	Cardiovascular diseases			Other non-communicable			Communicable		
	RRR	p	95% CI	RRR	p	95% CI	RRR	p	95% CI
Sex (Females)	1.26	<0.001	1.22-1.30	1.00	0.97	0.97-1.03	1.16	<0.001	1.08-1.24
Insurance (insured)	1.19	<0.001	1.15-1.23	1.27	<0.001	1.24-1.31	0.77	<0.001	0.73-0.82
Necropsy (performed)	1.42	<0.001	1.25-1.60	1.10	0.124	0.97-1.25	1.32	0.016	1.05-1.66
Place of Death (in hospital)	1.87	<0.001	1.81-1.92	1.42	<0.001	1.38-1.46	2.84	<0.001	2.67-3.03
Educational Level									
Below high school	0.73	<0.001	0.70-0.77	0.76	<0.001	0.73-0.79	0.97	0.486	0.87-1.07
Below college	0.89	0.001	0.84-0.95	0.91	0.003	0.86-0.97	0.92	0.184	0.80-1.04
College or more	1.00			1.00			1.00		
Age (years)									
20-24	0.22	<0.001	0.11-0.46	0.45	<0.001	0.31-0.66	2.61	<0.001	1.60-4.26
25-29	0.17	<0.001	0.09-0.33	0.62	0.001	0.48-0.81	4.48	<0.001	3.20-6.27
30-34	0.33	<0.001	0.24-0.44	0.67	<0.001	0.55-0.81	2.56	<0.001	1.92-3.39
35-39	0.38	<0.001	0.30-0.48	0.90	0.158	0.79-1.04	3.24	<0.001	2.59-4.05
40-44	0.48	<0.001	0.42-0.55	0.85	0.002	0.77-0.94	2.13	<0.001	1.78-2.55
45-49	0.63	<0.001	0.57-0.70	0.96	0.292	0.88-1.04	1.51	<0.001	1.28-1.78
50-54	0.65	<0.001	0.60-0.70	0.88	<0.001	0.83-0.94	1.24	0.001	1.09-1.42
55-59	0.73	<0.001	0.69-0.78	0.88	<0.001	0.83-0.93	1.06	0.399	0.93-1.20
60-64	0.85	<0.001	0.81-0.90	0.92	0.001	0.87-0.96	1.02	0.772	0.91-1.14
65-69	1.00			1.00			1.00		
70-74	1.52	<0.001	1.44-1.61	1.20	<0.001	1.14-1.27	1.44	<0.001	1.28-1.62
75-79	1.66	<0.001	1.57-1.76	1.27	<0.001	1.20-1.34	1.56	<0.001	1.38-1.76
80-84	1.83	<0.001	1.72-1.94	1.20	<0.001	1.14-1.28	1.79	<0.001	1.58-2.03
85+	1.72	<0.001	1.62-1.83	1.07	0.031	1.01-1.14	2.34	<0.001	2.06-2.64
BMI	1.20	<0.001	1.19-1.22	1.06	<0.001	1.05-1.08	1.15	<0.001	1.12-1.18
SBP	1.01	<0.001	1.01-1.02	1.00	0.092	0.99-1.00	1.01	<0.001	1.01-1.02

^a Cardiovascular diseases include rheumatic heart disease, hypertensive disease, ischaemic heart disease, cerebrovascular disease, inflammatory heart diseases, and other cardiac diseases. The corresponding ICD-10 codes are: I00-I99.

^b Other non-communicable diseases include malignant neoplasms, other neoplasms, endocrine disorders, neuro-psychiatric conditions, sense organ diseases, respiratory diseases, digestive diseases, genito-urinary diseases, skin diseases, musculo-skeletal diseases, congenital anomalies, and oral conditions. The corresponding ICD-10 codes are: C00-C97, D00-D48, D65-D89, E03-E07, E15-E16, E20-E34, E51-E88, F01-F99, G06-G98, H00-H61, H68-H93, J30-J98, K00-K92, N00-N64, N75-N98, L00-L98, M00-M99, Q00-Q99.

^c Communicable diseases include infectious and parasitic diseases, respiratory infections, maternal conditions, conditions arising during the perinatal period, and nutritional deficiencies. The corresponding ICD-10 codes are: A00-B99, G00-G04, N70-N73, J00-J06, J10-J18, J20-J22, H65-H66, O00-O99, P00-P96, E00-E02, E40-E46, E50, D50-D64

Notes:

1) Diabetes includes type I and II, malnutrition related, and other diabetes. The corresponding ICD-10 codes are E10-E14.

2) We did not include deaths assigned to injuries (intentional and unintentional) as the underlying cause of death in the statistical analysis of coding comparability because assignment to external causes is substantially more likely to be valid/comparable. The corresponding ICD-10 codes are V01-Y89.

3) NH refers to non-Hispanics. Age group 65-69 years, educational level of college or more, and the race-sex combination of white-NH-males in the US and males in Mexico were the absorbed categories (i.e. RRR = 1.0) for the models. All relative risk ratios are in reference to these groups.

TABLE 3. Observed and adjusted numbers and proportions of UCDs assigned to different disease clusters among deaths with diabetes as one of the MCDs in the United States (2001) and Mexico (2005).

United States (2001)									
		Diabetes		Cardiovascular diseases		Other non-communicable diseases		Communicable diseases	
		Observed	Corrected	Observed	Corrected	Observed	Corrected	Observed	Corrected
20-44	Male	1,580 (51%)	1,476 (47%)	864 (28%)	946 (30%)	507 (16%)	481 (15%)	174 (6%)	222 (7%)
	Female	1,076 (49%)	1,059 (48%)	523 (24%)	599 (27%)	488 (22%)	400 (18%)	131 (6%)	159 (7%)
45-60	Male	5,516 (38%)	5,067 (35%)	5,603 (39%)	5,975 (42%)	2,678 (19%)	2,658 (19%)	562 (4%)	659 (5%)
	Female	4,015 (39%)	3,564 (35%)	3,367 (33%)	4,377 (42%)	2,495 (24%)	1,911 (19%)	450 (4%)	475 (5%)
60+	Male	25,691 (30%)	24,747 (29%)	34,946 (41%)	37,369 (44%)	21,599 (25%)	19,174 (23%)	2,897 (3%)	3,843 (5%)
	Female	33,398 (33%)	27,960 (28%)	39,831 (40%)	49,316 (49%)	23,700 (24%)	18,406 (18%)	3,511 (3%)	4,757 (5%)
20+	Male	32,787 (32%)	31,290 (30%)	41,413 (40%)	44,289 (43%)	24,784 (24%)	22,313 (22%)	3,633 (4%)	4,725 (5%)
	Female	38,489 (34%)	32,584 (29%)	43,721 (39%)	54,293 (48%)	26,683 (24%)	20,717 (18%)	4,092 (4%)	5,391 (5%)
Mexico (2005)									
		Diabetes		Cardiovascular diseases		Other non-communicable diseases		Communicable diseases	
		Observed	Corrected	Observed	Corrected	Observed	Corrected	Observed	Corrected
20-44	Male	1,785 (73%)	1,475 (60%)	132 (5%)	262 (11%)	370 (15%)	512 (21%)	172 (7%)	210 (9%)
	Female	1,307 (75%)	1,119 (64%)	96 (5%)	145 (8%)	244 (14%)	360 (21%)	102 (6%)	125 (7%)
45-60	Male	7,134 (70%)	5,455 (53%)	1,128 (11%)	2,107 (21%)	1,659 (16%)	2,234 (22%)	331 (3%)	455 (4%)
	Female	6,656 (70%)	5,520 (58%)	969 (10%)	1,537 (16%)	1,536 (16%)	2,039 (22%)	286 (3%)	352 (4%)
60+	Male	20,339 (65%)	14,642 (47%)	4,817 (15%)	8,822 (28%)	5,189 (17%)	6,539 (21%)	874 (3%)	1,216 (4%)
	Female	26,367 (67%)	20,089 (51%)	5,925 (15%)	9,663 (25%)	5,880 (15%)	8,193 (21%)	1,211 (3%)	1,438 (4%)
20+	Male	29,264 (67%)	21,578 (49%)	6,079 (14%)	11,194 (25%)	7,218 (16%)	9,285 (21%)	1,377 (3%)	1,881 (4%)
	Female	34,338 (68%)	26,735 (53%)	6,991 (14%)	11,345 (22%)	7,663 (15%)	10,595 (21%)	1,601 (3%)	1,917 (4%)

FIGURE 1. Distribution of the UCD among deaths for which diabetes was included as one the MCDs.
 Note: ONC refers to the category “other non-communicable diseases”; C refers to “communicable diseases”

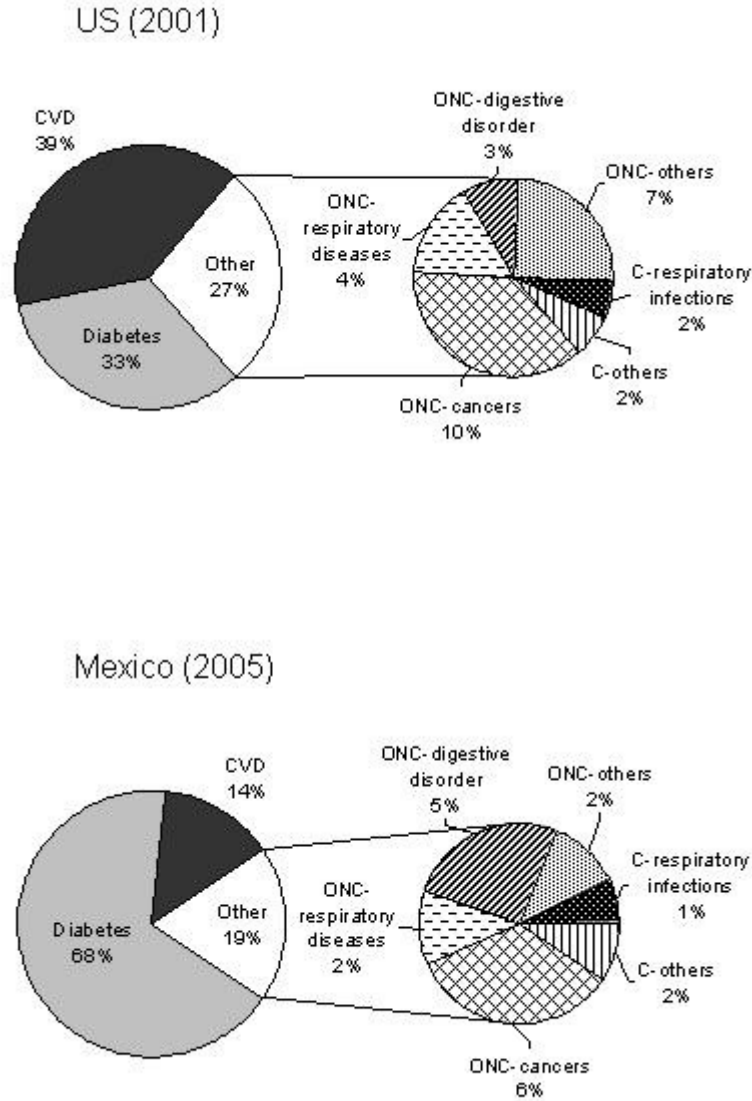


FIGURE 2. Death rates of diabetes mellitus (DM) as the underlying cause of death (UCD) versus anywhere in the multiple contributing causes of death (MCD) for US states and the District of Columbia (2001), and Mexican states and the Federal District (2005). Deaths in ages ≥ 20 years are included. Rates in each state are age-standardized to their country's 2000 population.

