Differences in Diabetes Prevalence, Incidence, and Mortality Among the Elderly of Four Racial/Ethnic Groups: Whites, Blacks, Hispanics, and Asians

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OBJECTIVE — To examine diabetes prevalence, incidence, and mortality from 1993 to 2001 among fee-for-service Medicare beneficiaries ≥67 years of age.

RESEARCH DESIGN AND METHODS — This study was a retrospective analysis of a 5% random sample of Medicare fee-for-service beneficiaries ≥65 years of age in each year.

RESULTS — In 1993, the prevalence of diabetes among those ≥67 years of age was 145 cases per 1,000 individuals. By 2001, it was 197/1,000, an increase of 36.0%. The 2001 prevalence among Hispanics (334/1,000) was significantly higher than among blacks (296/1,000), Asians (243/1,000), and whites (184/1,000, $P < 0.0001$). During the 7-year period the greatest increase in diabetes prevalence was among Asians (68.0%). Between 1994 and 2001, the annual rate of newly diagnosed elderly individuals with diabetes increased by 36.9%. Hispanics had the greatest increase at 55.0%. The mortality rate among individuals with diabetes decreased by ~5% between 1994 and 2001 from 92.1/1,000 to 87.2/1,000 ($P < 0.001$), due to a 6% decrease among whites. No decrease in mortality was seen among elderly individuals without diabetes, it was 55/1,000 in 1994 and 54/1,000 in 2001.

CONCLUSIONS — The dramatic increase in the incidence and prevalence of diabetes likely reflect a combination of true increases, as well as changes in the diagnostic criteria and increased interest in diagnosing and appropriately treating diabetes in the elderly. Improved treatment may have had an impact on mortality rates among individuals with diabetes, although they could have been influenced by the duration of diabetes before diagnosis, which has likely decreased. Changes in incidence, prevalence, and mortality in elderly individuals with diabetes need to continue to be monitored.

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The number of individuals reported to have diabetes in the U.S. has increased by ~100% over the past two decades, and by 2050, it is expected to increase by an additional 165% (1–6). The current burden of diabetes is greatest in the population ≥65 years of age (1–4,7–9), and the greatest increases in prevalence are expected among the elderly: from 252% among women 65–74 years of age to 537% among men ≥75 years of age (6).

An explicit goal of *Healthy People 2010* and the President's Initiative on Racial and Ethnic Disparities is to eliminate racial disparities in health and health care by 2010 (9,10). Objective 5-3 of *Healthy People 2010* is to "reduce the overall rate of diabetes that is clinically diagnosed." Thus, it is important that the prevalence and incidence of diabetes be monitored during this decade among individuals of all racial/ethnic groups, particularly those known to have higher rates of diabetes: blacks, Hispanics, and Native Americans.

The Medicare administrative data available from the Centers for Medicare and Medicaid Services are national population-based databases that have been used to determine the prevalence of diabetes in the U.S. elderly population (11–13).

The purpose of this work is to describe the prevalence and newly diagnosed cases of diabetes among Medicare elderly beneficiaries in the years 1993–2001, as well as mortality rates among individuals with diabetes. Comparisons are made between four racial/ethnic groups (whites, blacks, Hispanics, and Asians), five age-groups, and both sexes.

RESEARCH DESIGN AND METHODS

— For evaluating subjects during the period 1992 through 2001, we used the following annual 5% Medicare enrollment and claims-based files: Denominator, Hospital Inpatient, Skilled Nursing Facility (SNF), Carrier, Outpatient, and Home Health Agency (HHA). Approximately 98% of the U.S. population aged ≥65 years is enrolled in Medicare. The 5% Medicare files include information on a 5% random sample of beneficiaries. The Denominator files provided demographic information and Medicare and managed care enrollment status. The Carrier file contains records based on claims submitted by physicians

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Abbreviations: BRFSS, Behavioral Risk Factor Surveillance System; CDC, Centers for Disease Control and Prevention; DSS, Diabetes Surveillance System; HHA, Home Health Agency; MCBS, Medicare Current Beneficiary Survey; NHANES, National Health and Nutrition Examination Survey; SNF, Skilled Nursing Facility; VA, Department of Veterans Affairs.

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

and other noninstitutional providers of care. The information captured from the five claims-based files included diagnoses and dates of service.

Identification of individuals with diabetes

The diagnosis codes in the Inpatient, SNF, Carrier, Outpatient, and HHA files were searched for 2 years (e.g., 1992 and 1993) to determine the prevalence of cases of diabetes at the end of the 2-year period (i.e., on 31 December 1993, etc.). We have previously validated this method (11). We searched all diagnosis positions in the claims files for ICD-9-CM codes 250.XX, diabetes; 357.2, diabetic nephropathy; 362.01–362.02, diabetic retinopathy; and 366.41, diabetic cataract. Any person with one hospitalization, one SNF stay, one HHA record, two Outpatient visits, or two Carrier line item records with one of the diagnoses was identified as having diabetes. For the Outpatient claims and the Carrier line items, the services must have been provided on different days. This method has a sensitivity of 0.75, a specificity of 0.97, and a positive predictive value of 0.88 compared with self-reported diabetes (11). The 2-year search means that our estimates can only be made for those individuals who are ≥67 years of age.

Exclusion criteria

We excluded individuals *1*) who did not have both Medicare Part A and Part B coverage during any time during the period used to define a case (they were excluded because they would have no claims for one or more of the files included in our case-finding algorithm; this resulted in a loss of ~6% of the population [14]); *2*) who had been diagnosed with end-stage renal disease during the analysis period; *3*) who did not reside in the 50 states, DC, or Puerto Rico; and *4*) who belonged to a managed care organization during the study period. This is done routinely in studies of Medicare beneficiaries using claims data because no claims are submitted for Medicare Part B services. During the period of our study, 4% (1992) to 16% (1999) of the Medicare population was enrolled in managed care.

Coding of race/ethnicity

The Medicare race variable is a single byte. Thus, Hispanic is treated as a race and not an ethnicity, and Medicare beneficiaries must choose between Hispanic and white, black, etc.

Statistical analysis

For each year, the crude and adjusted diabetes prevalence and the percentage of the population with newly diagnosed diabetes (incidence) were calculated, as was the mortality for each calendar year's prevalence cohort. The denominator for the prevalence calculations was the population alive on 31 December 199X or 200X. The denominators for the incidence calculations were the beneficiaries without diabetes alive on 1 January 199X or 200X who continued their Part A and B coverage. The denominators for the mortality calculations were the beneficiaries with diabetes, or without diabetes, alive on 1 January 199X or 200X. Direct adjustment was used to calculate the adjusted prevalence rate of diabetes, with the 2000 5% Medicare population as the reference. A logistic regression model was used to estimate the predicted 1-year incidence rates of diabetes, with age, sex, and race/ethnicity as covariates. Using model-based adjustment, and with the 2000 5% Medicare population as the reference, these rates were further adjusted for the same covariates. Adjusted 1-year death rates were obtained following the same method.

Comparisons of adjusted prevalence rates of diabetes between different demographic groups were done using the z statistic. For incidence rates of diabetes and death rates, a logistic regression model was used for testing the differences in the adjusted rates between different demographic groups. Comparisons of rates for different years within a demographic group were done using the bootstrap method with 1,000 iterations (15,16). All analyses were performed using SAS version 8.2 (SAS, Cary, NC).

RESULTS — The estimated adjusted prevalence of diabetes in the elderly Medicare population on 31 December 1993 was 145 cases per 1,000 individuals (Table 1 and Fig. 1). It increased to 197/1,000 in 2001, a 36.0% increase, representing 4,532,520 individuals with diabetes.

The highest prevalence was seen among minority groups. Hispanics and blacks had the highest prevalence in all years. It increased from 241/1,000 and 222/1,000, respectively, in 1993, to 334/1,000 and 296/1,000, respectively, in 2001. Throughout the period the prevalence was 8.4–13.0% greater among Hispanics than among blacks ($P < 0.0001$). The greatest percentage increase in prevalence was seen among Asians. Between 1993 and 2001 their adjusted prevalence went from 144/1,000, a rate similar to that of whites (135/1,000, $P = 0.157$), to 243/1,000, a 68.0% increase. Prevalence increased with age, peaking among those 75–79 years of age (211/1,000 in 2001) and then decreasing.

Between 1994 and 2001, the number of individuals aged ≥67 years newly diagnosed with diabetes each year increased from 544,140 to 660,240 (Table 2). The adjusted incidence increased from 27/1,000 in 1994 to 37/1,000 in 2001, a 36.9% increase. The highest rates of newly diagnosed cases of diabetes were seen among the minority groups, also. Compared with whites, for all years the incidence among Hispanics, blacks, and Asians were 90 to 140, 53 to 60, and 26 to 48% greater, respectively.

Between 1994 and 2001, the number of individuals with diabetes aged ≥67 years who died each year increased from 300,540 to 359,480 (Table 3). However, the mortality rate, which was essentially unchanged from 1994 to 1999 at 92/1,000, decreased to <90/1,000 in 2000 (data not shown) and was 87.2/1,000 in 2001, or 95% of the 1994 rate ($P < 0.001$). The highest adjusted mortality rates in 2001 were among blacks and whites, 91.7/1,000 and 87.7/1,000, respectively, a nonsignificant difference ($P = 0.13$). Mortality rates among the other two minority groups were significantly lower than those among whites, 72.5/1,000 among Hispanics and 56.3/1,000 among Asians. Between 1994 and 2001, the 6% decrease among whites was statistically significant ($P < 0.001$). The 21% decrease among Asians was not ($P = 0.262$). There was no change among blacks or Hispanics.

The age-group–specific mortality rates increased with age from <40/1,000 in those individuals with diabetes 67–69 years of age to slightly >200/1,000 in those ≥85 years of age in 2001. If the age-group information in Table 3 is combined into larger groups in order to be more similar to other published information, there is an approximate doubling of the mortality rate for each additional decade. For example, in 2001, the unadjusted mortality rate among those 67–74 years of age was 46/1,000; among those 75–84 years of age, it was 90/1,000; and among those ≥85 years of age, it was 203/1,000 (data not shown).

The estimated adjusted 1-year mortality among elderly Medicare beneficiaries without diabetes in 1994 was 55/1,000, and it remained essentially unchanged for the next 7 years (Table 3). As with individuals with diabetes, the highest adjusted mortality rates were among blacks and whites. For example, in 2001, they were 61/1,000 and 54/1,000, respectively.

CONCLUSIONS — Reports of the continuing increase in the prevalence of diabetes among elderly Americans are not new (2–7). What is of concern is that in 2001 the highest prevalence and incidence were seen among the minority groups we studied and that the highest rates of increases were among Hispanics and Asians.

The prevalence information we present on the elderly Medicare fee-for-service population is consistent with information reported by the Diabetes Surveillance System (DSS) and the Behavioral Risk Factor Surveillance System (BRFSS) of the National Centers for Disease Control and Prevention (CDC) (3,4). In 2001, the DSS estimated prevalence rates of 164/1,000 and 139/1,000 for the age-groups 65–74 years and ≥75, respectively, representing increases of 56.4 and 34.0% between 1993 and 2001. The prevalence of diabetes among individuals aged ≥65 years reported by the BRFSS for the median state was 116/1,000 in 1993 and 149/1,000 in 2001, an increase of 28.4%. The most recent information from the National Health and Nutrition Examination Survey (NHANES) indicates a slower growth in self-reported diabetes (19.7%) from 127/1,000 in 1988–1994 to 152/1,000 in 1999–2000 in individuals aged ≥60 years (17). All of these surveys exclude institutionalized individuals, which would bias their estimates downward compared with ours. Information from the Medicare Current Beneficiary Survey (MCBS) indicated that the self-reported rate of diabetes among community-dwelling Medicare beneficiaries for 1996–2000 was between 0.79 and 0.96 of the rate in the institutionalized beneficiaries (18).

One unanswered question is how

Table 1—*Estimated number and adjusted prevalence of diabetes per 1,000 Medicare elderly fee-for-service beneficiaries, selected years 1993–2001**

	1993		1995		1997		1999		2001		Percent increase:
	n	Prevalence	*n*	Prevalence	*n*	Prevalence	*n*	Prevalence	*n*	Prevalence	1993 to 2001
Total	3,476,340	145	3,680,200	153	3,787,720	165	4,050,000	181	4,532,520	197	36.0†
Age (years)											
67–69	630,440	134‡	639,740	142‡	613,240	152‡	632,080	171‡	703,340	186‡	38.3†
70–74	1,056,420	147‡	1,114,100	156‡	1,121,520	169‡	1,156,320	184‡	1,269,200	200‡	35.8†
75–79 (ref.)	841,780	154	890,420	162	948,540	175	1,058,560	194	1,173,800	211	36.7†
80–84	551,280	150§	603,520	159§	632,440	171§	682,660	187‡	798,280	202‡	34.9†
≥85	396,420	129‡	432,420	135‡	471,980	147‡	520,380	160‡	587,900	173‡	34.4†
Sex											
Male (ref.)	1,398,180	147	1,482,280	157	15,552,040	171	1,673,780	190	1,907,900	207	41.0†
Female	2,078,160	143‡	2,197,920	150‡	2,235,680	160‡	2,376,220	175‡	2,624,620	189‡	32.7†
Race/ethnicity											
White (ref.)	2,944,460	135	3,096,340	143	3,145,600	154	3,357,920	169	3,749,200	184	35.8†
Black	409,480	222‡	432,260	236‡	429,080	256‡	452,160	278‡	505,340	296‡	32.9†
Hispanic	42,060	241‡	52,920	255‡	113,540	276‡	131,560	317‡	143,720	334‡	38.5†
Asian	9,980	144	15,100	173‡	38,100	194‡	49,940	220‡	62,220	243‡	68.0†

All rates are adjusted using the 2000 population. The age categories in the standard population are 67–69, 70–74, 75–79, 80–84, and ≥85 years old. The race/ethnicity categories are white, black, Hispanic, Asian, and other/unknown. Total rates are adjusted for age, sex, and race/ethnicity; rates by age for sex and race/ethnicity; rates by sex for age and race/ethnicity; and rates by race/ethnicity for age and sex. **n* indicates the number of individuals with diabetes alive on 31 December 199X or 2001; †$P < 0.001$ between adjusted rate in 1993 and adjusted rate in 2001; ‡$P < 0.0001$ and §$P < 0.01$ between adjusted rate for reference demographic subgroup in 199X or 2001 and the demographic subgroup in that line.

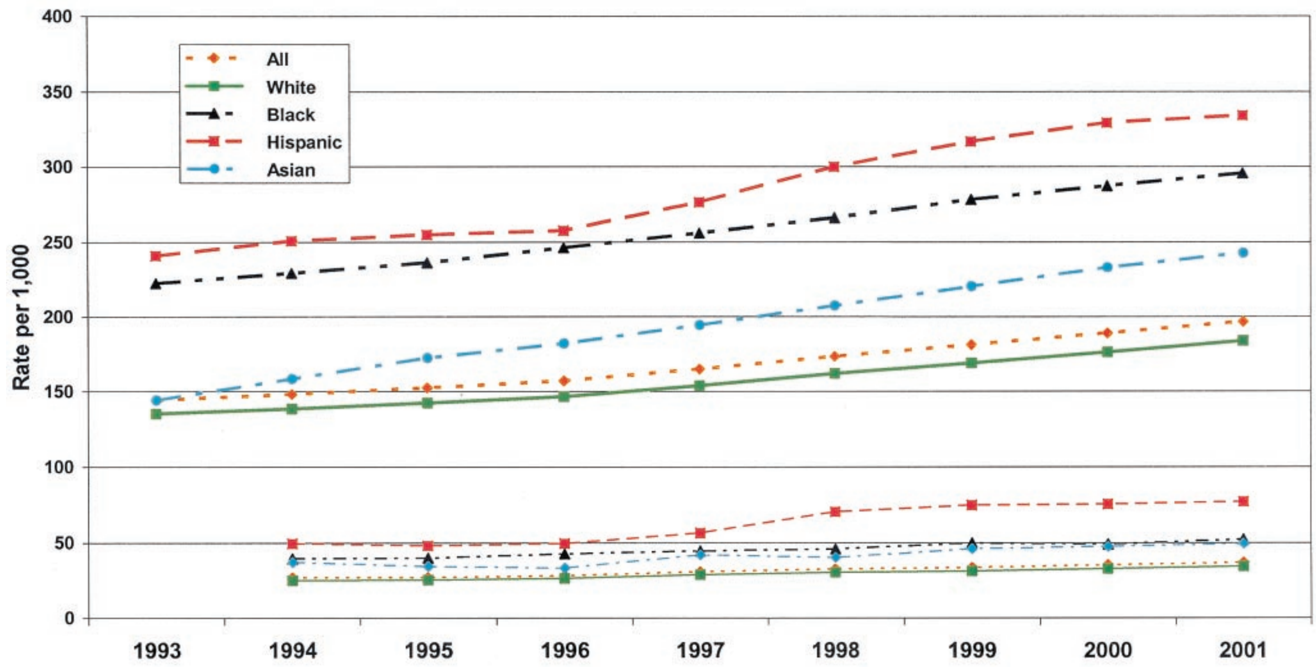

Figure 1—*Prevalence (upper series) and incidence (lower series) of diabetes per 1,000 elderly Medicare beneficiaries, 1993–2001.*

much the reported increases in prevalence and incidence using the Medicare databases, DSS, and BRFSS reflect true increases versus other factors. The 1999–2000 NHANES information, cited earlier, indicated that the 19.7% increase in self-reported diabetes prevalence was accompanied by a decrease in undiagnosed diabetes, resulting in the total prevalence for the two periods being similar, 190/1,000 in 1988–1994 and 193/1,000 in 1999–2000 (17). However, as pointed out in the Editorial Note of that report, "the lack of increase in prevalence is unexpected in light of the increasing prevalence of obesity and overweight in U.S. adults documented by the NHANES." Also, because an oral glucose tolerance test was not performed in NHANES 1999–2000, the 1999–2000 survey does not capture the additional proportion of

Table 2—*Estimated number and adjusted rate of individuals with newly diagnosed diabetes per 1,000 Medicare elderly fee-for-service beneficiaries without diabetes, selected years 1994–2001**

	1994		1995		1997		1999		2001		Percent increase: 1994 to 2001
	n	Rate	*n*	Rate	*n*	Rate	*n*	Rate	*n*	Rate	
Total	544,140	26.8	548,540	26.9	603,320	30.7	614,680	33.5	660,240	36.7	36.9†
Age (years)											
67–69	103,500	25.6‡	105,680	26.5	107,080	29.5‡	101,300	32.0§	105,800	35.8	39.8†
70–74	163,980	27.0	166,200	27.2	175,640	30.7	176,540	33.7	184,660	36.9	36.7†
75–79 (ref.)	125,220	27.4	122,220	26.9	142,100	31.4	149,100	34.5	161,880	37.4	36.5†
80–84	85,600	27.8	86,420	27.5	95,940	30.9	102,560	34.5	112,720	37.6	35.3†
≥85	65,840	25.1‡	68,020	25.4	82,560	30.3	85,180	31.6§	95,180	34.7‡	38.2†
Sex											
Male (ref.)	234,000	29.0	237,620	29.3	258,780	33.5	262,340	36.4	283,340	39.9	37.6†
Female	310,140	25.2§	310,920	25.2§	344,540	28.7§	352,340	31.5§	376,900	34.5§	36.9†
Race/ethnicity											
White (ref.)	470,220	25.0	473,400	25.2	513,800	28.8	515,880	31.1	560,940	34.3	37.2†
Black	55,260	39.5§	55,740	39.9§	57,540	44.6§	58,160	49.9§	60,200	52.3§	32.4†
Hispanic	6,480	49.6§	6,960	48.1§	16,840	65.4§	21,080	74.6§	21,300	76.9§	55.0†
Asian	2,120	37.1§	2,320	34.3	6,260	41.9§	7,060	46.1§	8,960	49.4§	33.2†

All rates are adjusted using the 2000 population. The age categories in the standard population are 67–69, 70–74, 75–79, 80–84, and ≥85 years old. The race/ethnicity categories are white, black, Hispanic, Asian, and other/unknown. Total rates are adjusted for age, sex, and race/ethnicity; rates by age for sex and race/ethnicity; rates by sex for age and race/ethnicity; and rates by race/ethnicity for age and sex. **n* indicates the number of individuals with newly diagnosed diabetes during 1999X or 2001; †$P < 0.001$ between adjusted rate in 1994 and adjusted rate in 2001; ‡$P < 0.001$ and §$P < 0.0001$ between adjusted rate for reference demographic subgroup in 199X or 2001 and the demographic subgroup in that line.

Table 3—*Number of deaths and adjusted 1-year all-cause mortality rates per 1,000 elderly Medicare fee-for-service beneficiaries with diabetes and those without diabetes, selected years 1994–2001**

	1994		1995		1997		1999		2001		
	n	Mortality rate	*n*	Mortality rate	*n*	Mortality rate	*n*	Mortality rate	*n*	Mortality rate	Ratio: 2001 to 1994
Individuals with diabetes											
Total	300,540	92.1	313,900	93.1	326,400	92.3	347,980	92.3	359,480	87.2	0.95†
Age (years)											
67–69 (ref.)	27,400	42.9	28,440	43.8	27,540	43.5	26,360	42.3	25,180	38.4	0.90‡
70–74	60,620	56.7§	64,780	58.1§	61,380	54.8§	62,680	54.5§	60,500	50.1§	0.88†
75–79	70,480	83.1§	70,600	81.9§	75,020	81.3§	78,500	79.0§	83,680	75.1§	0.90†
80–84	65,380	119.2§	68,000	118.2§	73,640	120.4§	77,240	117.7§	81,440	112.5§	0.94‡
≥85	76,660	198.1§	82,080	205.4§	88,820	204.4§	103,200	212.5§	108,680	202.2§	1.02
Sex											
Male (ref.)	130,560	106.8	139,800	110.5	144,600	108.7	149,680	105.2	155,180	97.8	0.92†
Female	169,980	83.5§	174,100	83.0§	181,800	82.7§	198,300	84.9§	204,300	81.1§	0.97
Race											
White (ref.)	258,600	92.9	268,400	93.5	276,320	92.7	293,740	92.7	304,480	87.7	0.94†
Black	32,640	91.3	35,460	95.7	36,560	95.1	37,840	96.5	39,200	91.7	1.00
Hispanic	2,260	69.1‖	2,960	77.0	6,220	74.1§	8,260	79.6¶	8,900	72.5§	1.05
Asian	600	71.2	860	77.6	2,140	72.8¶	2,280	62.8§	2,840	56.3§	0.79
Individuals without diabetes											
Total	1,062,940	54.7	1,079,100	55.2	1,054,020	54.8	1,013,100	55.0	989,160	54.0	0.99
Age (years)											
67–69 (ref.)	83,220	19.8	82,000	19.9	71,380	19.1	60,800	18.8	53,080	17.4	0.88†
70–74	170,640	27.0§	170,660	27.0§	155,660	26.6§	139,040	26.0§	127,940	25.2§	0.93†
75–79	203,940	43.4§	200,560	43.1§	196,680	42.6§	181,340	41.3§	182,040	41.6§	0.96†
80–84	221,660	71.2§	229,860	72.6§	223,460	71.4§	215,340	71.3§	208,500	69.1§	0.97
≥85	383,480	146.2§	396,020	148.0§	406,840	148.6§	416,580	153.8§	417,600	151.6§	1.04†
Sex											
Male (ref.)	487,400	70.4	482,080	69.5	458,220	68.0	431,960	67.6	421,480	66.0	0.94†
Female	575,540	45.3§	597,020	46.6§	595,800	46.9§	581,140	47.5§	567,680	46.7§	1.03†
Race/ethnicity											
White (ref.)	958,860	54.6	971,460	55.0	946,960	54.6	913,560	55.1	892,460	53.9	0.99
Black	79,660	61.0§	82,640	62.8§	78,660	63.2§	70,280	60.9§	69,320	61.1§	1.00
Hispanic	4,100	39.2§	4,940	43.6‖	10,240	43.6§	9,540	40.2§	10,920	43.3§	1.10
Asian	2,260	47.5	2,680	47.2	4,700	38.4§	5,180	38.2§	6,140	37.1§	0.78

All rates are adjusted using the 2000 population. The age categories in the standard population are 67–69, 70–74, 75–79, 80–84, and ≥85 years old. The race/ethnicity categories are white, black, Hispanic, Asian, and other/unknown. Total rates are adjusted for age, sex, and race/ethnicity; rates by age for sex and race/ethnicity; rates by sex for age and race/ethnicity; and rates by race/ethnicity by age and sex. **n* indicates the number of deaths among individuals with diabetes in 31 December 199X or 2001; †$P < 0.001$ and ‡$P < 0.01$ between adjusted rate in 1994 and adjusted rate in 2001; §$P < 0.0001$, ‖$P < 0.001$, and ¶$P < 0.01$ between adjusted rate for reference demographic subgroup in 199X or 2001 and the demographic subgroup in that line.

people with normal fasting glucose levels who have abnormal postload glucose tolerance, which in the previous NHANES had raised the prevalence of glucose intolerance by 36% (19). Engelgau et al. (20) from CDC recently included "changing diagnostic criteria and improved or enhanced detection" in their reasons for the uptrend in self-reported prevalence. Supporting their contention is the July 1997 recommendation of new criteria for the diagnosis of diabetes by The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus (21) and the results of the U.K. Prospective Diabetes Study in 1998 (22). The former reduced the fasting plasma glucose level required for the diagnosis of diabetes from ≥140 to >125 mg/dl. The latter provided clinicians with randomized trial information that the aggressive treatment of individuals with type 2 diabetes could delay or prevent the onset of microvascular complications of diabetes. Thus, they would be more motivated to identify individuals at risk of diabetes earlier because they had available, effective treatment. Comparisons of the average annual increases in prevalence and incidence in the Medicare elderly (Tables 1 and 2 and Fig. 1) during the period 1993 (or 1994 for incidence) through 1996 with the period 1997 through 2001 show greater increases in the latter period. The average increase in prevalence from 1996 to 2001 was 8/1,000, twofold greater than that of the period from 1993 to 1996 (4.0/1,000). Similarly, the annual increase in incidence for the latter period was 1.7/1,000, 2.65 times greater than that of the period from 1994 to 1996 (0.6/1,000). The DSS and BRFSS also show greater average annual increases in the prevalence of self-reported diabetes from 1996 (BRFSS) and 1997 (DSS) through 2001, for the total adult population and the elderly, respectively (3,4).

We found the greatest increase in prevalence among Hispanics (38.5%) and Asians (68.0%). There are little published data with which to compare this trend information. The DSS began reporting prevalence information for Hispanics beginning in 1997, but no information is yet provided for Asians. Our prevalence estimate for Hispanics in 2001 (334/1,000) is 39.7% greater than an estimate of 239/1,000 for Hispanics, which can be made from the DSS information (3). Our finding of a greater prevalence is likely because the population of Hispanic Medicare beneficiaries is different from the Hispanic population included in the National Health Interview Survey used by the DSS. The vast majority of Medicare beneficiaries earn the entitlement to Medicare by working ≥40 quarters in jobs for which Medicare taxes are paid. Thus, Hispanics in the Medicare program are more likely to have lived in the U.S. for a longer period of time on average than those who are sampled in the National Health Interview Survey, which is based on the current place of residence. This could contribute to a higher true prevalence due to the adoption of a more westernized lifestyle (23–25), as well as an increased opportunity to be diagnosed by a health care provider because of greater access to health care among those who are Medicare beneficiaries. The dramatic increase of diabetes among Asian Americans was probably due to similar factors. Studies have documented increased rates of diabetes among Asian-American immigrants (23–25) related to the duration of time in the U.S. and a westernization of their lifestyle, particularly in diet. A recent study of East Coast Japanese immigrants, described as less acculturated newcomers than other Japanese, reported a prevalence of diabetes in the adult Japanese Americans that was only two-thirds that of all adults in the area (46/1,000 vs. 68/1,000, respectively) (26).

The difficulty of determining a national estimate of the mortality rate among individuals with diabetes has been discussed (1). A strength of the Medicare databases is knowledge of the date of death of beneficiaries. This information must be reported to the Social Security Administration for deceased beneficiaries, and the Social Security Administration provides that information to Centers for Medicare and Medicaid Services. The lower mortality rates among Hispanics and Asians with diabetes than among whites and blacks are consistent with the lower mortality rates we found among those without diabetes, reports of all-cause mortality reported by the National Center for Health Statistics (27), and the recent report of Bertoni et al. using Medicare data from 1995 to 1999 (28).

We found that the only significant decrease in mortality among individuals with diabetes of the different racial/ethnic groups was among whites. The possible reasons for this, such as better access to diabetes care, are outside the scope of this study and should be followed up. In a report to the CDC, we found higher rates of HbA_{1c} testing and eye examination in 1994 among white, fee-for-service, elderly Medicare beneficiaries than among blacks and the other ethnicity groups combined (12). We, and others, have also reported that elderly whites enrolled in Medicare managed care plans are more likely to receive recommended diabetes care and have lower rates of poor HbA_{1c} control than either blacks or Hispanics (29–32).

The increased risk of death among individuals with diabetes compared with individuals without diabetes is well documented (1,3,22,28). We found the overall risk of dying among elderly Medicare beneficiaries to be 1.6 times greater than the rate among individuals without diabetes. This is consistent with the ratio of 1.5 presented by Gu et al. (33) for individuals 65–74 years of age in 1971 and the ratio of 1.6 found by Bertoni et al. (28) for 1995–1999. Based on information in Table 11.1 in *Diabetes in America*, race-specific ratios of 2.2 for whites and 1.4 for blacks can be estimated for 1986 (1). Our estimates for 2001 are 1.6 and 1.5, respectively (Table 3). Our ratios in 2001 for Hispanics and Asians were 1.7 and 1.5, respectively.

The strength of this study lies in the large number of individuals available for monitoring, even in the 5% sample of Medicare beneficiaries. We have been able to produce estimates for more age-groups than usually described in other national data, as well as an additional racial/ethnic group (Asians). Because of the sample size, we did not have to average our data over a 3-year period, as is done by the DSS. Also, comparisons with DSS data show a much greater stability in our estimates among the minority populations.

Potential weaknesses include the misclassification of diabetes and of race/ethnicity among some beneficiaries. Claims-based analyses of diabetes epidemiology will result in a certain amount of misclassification of cases. Our earlier study that described and validated the algorithm we used, and that has been used by others, indicated a sensitivity of 0.75, specificity of 0.97, and a positive predictive value of 0.84 using 1991 and 1992 claims data (11). Thus, our estimated prevalence will be less than the true value, assuming that self-reported diabetes (which is what we used for the gold standard) is truly a gold standard. However, with the very high positive predictive value, the great majority of those identified as having diabetes have the disease. Another issue that could impact a longitudinal study such as ours is a change in the sensitivity of the measurement method (as happened with the National Health Interview Survey in 1997 [3]) that would increase or decrease the accuracy of the information. To verify the accuracy of our measurement method, we repeated the Hebert et al. (11) study. We found that compared with 1992–1993, the sensitivity of the claims-based algorithm using 2000 and 2001 claims data had increased by slightly <25% to 0.89. Thus, approximately one-fourth of the 36% increase in prevalence that we report may be due to this improvement in the algorithm to detect individuals with diabetes.

Arday et al. (34) validated the Medicare race variable using administrative data and self-reported MCBS information from 1997. While the sensitivity for whites and blacks was very high (0.97 and 0.95, respectively), it was 0.39 and 0.58 for Hispanics and Asians, respectively. The positive predictive value was ≥0.96 for whites, blacks, and Hispanics and 0.79 for Asians. Thus, individuals identified as a particular race/ethnicity had a very high probability of that being correct. Because the race/ethnicity information has been continuously updated by Medicare, this is likely to have improved the accuracy over that reported by Arday et al.

Finally, including only those who use Medicare-reimbursed services limits the generalizability of the results to all elderly Americans. The largest groups we excluded are those in Medicare managed care (4–16%, annually), those who use the Department of Veterans Affairs (VA) services, and those without Medicare Part B coverage. The MCBS, which includes Medicare beneficiaries in managed care, estimated the prevalence of self-reported diabetes among all beneficiaries aged ≥65 years in 2000 as 177/1,000 compared with our estimate of 189/1,000 in those aged ≥67 years (18), indicating that Medicare beneficiaries in managed care likely have lower rates of diabetes and would lower our prevalence estimates if they could be included. Most VA patients ≥65 years of age are eligible for Medicare, and the majority of VA patients use non-VA services for part or all of their health care, so they would likely be included in our cases (35–37). On the other hand, there is an unknown percentage of the Medicare-eligible elderly, particularly men, who use VA services exclusively. Because the rate of diabetes is higher among VA users (7,38), their exclusion reduced our incidence and prevalence estimates.

In summary, we have documented major increases in the prevalence and incidence in all 5-year age-groups, in both sexes, and among the racial/ethnic groups white, black, Hispanic, and Asian between the early 1990s and 2001. The greatest increases were seen among two minority populations: Hispanics and Asians. The two groups with the highest prevalence, blacks and Hispanics, are the two in which there was no indication of a possible decrease in mortality.

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Jiannong Liu performed the bootstrapping.

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