Trends in Diabetes Prevalence and Diabetes-Related Complications in Older Mexican Americans From 1993–1994 to 2004–2005

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OBJECTIVE — Evidence has shown that Mexican Americans have a higher prevalence of diabetes and a greater risk for diabetes-related complications than non-Hispanic whites. However, no studies have described the changes in prevalence among older Mexican Americans. The purpose of this study was to expand on the current literature by examining the trends in diabetes prevalence and diabetes-related complications in Mexican Americans aged ≥75 years from 1993–1994 to 2004–2005.

RESEARCH DESIGN AND METHODS — The prevalences of self-reported diabetes and diabetes-related complications were estimated in the original cohort (1993–1994) and the new cohort (2004–2005) of the Hispanic Established Population for the Epidemiologic Study of the Elderly (Hispanic EPESE) and were compared across the two surveys.

RESULTS — The prevalence of diabetes among Mexican Americans aged ≥75 years has nearly doubled between 1993–1994 and 2004–2005 from 20.3 to 37.2%, respectively ($P <$ 0.001). The increase in the prevalence of diabetes was similar across all sociodemographic factors. Diabetes complications did not change significantly between the two cohorts. However, the prevalence of having any lower-extremity function disability did increase between the two cohorts.

CONCLUSIONS — The prevalence of diabetes in older Mexican Americans has increased dramatically. At the same time, there has been no improvement in diabetes-related complications as has been found in the general older population. These findings heighten the urgency for more effective public health interventions targeted to this population. As diabetes and obesity become more prevalent in older adults, physicians should encourage appropriate management in older patients, including early detection and glycemic control.

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Diabetes is the seventh leading cause of death in the U.S., affecting 16.8 million Americans in 2006 (1). The prevalence of diabetes among individuals aged ≥75 years is projected to increase 336% by 2050 (2). This upward trend is attributed mainly to the aging of the population, an increase in obesity, and lifestyle changes (3–5). Simultaneously, there has been a decrease in the prevalence of several diabetes-related complications as a result of advancements in diabetes management (6).

Older Hispanics are a rapidly growing segment of the U.S. population (7). During 1999 and 2002, diabetes was diagnosed in 24.9% of older Mexican Americans (aged ≥65 years) compared with only 14.3% of non-Hispanic white adults of the same age (8). Mexican Americans also have an increased risk and prevalence of diabetes-related complications and a higher disability rate compared with non-Hispanic whites (9,10). As overall life expectancy has increased, many Mexican Americans are living longer with more comorbidities including diabetes (9). Although several studies have examined the national trends of diabetes over the previous decades, no studies have examined the trends in diabetes prevalence and diabetes-related complications among older Mexican Americans. Hence, the purpose of this study was to expand on the current literature by examining the trends in diabetes prevalence and diabetes-related complications over the period 1993–1994 to 2004–2005, comparing two separate representative samples from the Hispanic Established Population for the Epidemiologic Study of the Elderly (Hispanic EPESE), a community-based study of older Mexican Americans (aged ≥65 years) residing in five southwestern states. This analysis builds on earlier work with the baseline data from this study, which showed high rates of diabetes and diabetes complications in older Mexican Americans in 1993–1994 (11–14).

RESEARCH DESIGN AND METHODS

— Data from the original cohort surveyed in 1993–1994 and the new cohort surveyed in 2004–2005 of the Hispanic EPESE, a community-based study of older noninstitutionalized Mexican Americans residing in five southwestern states (Texas, California, Arizona, Colorado, and New Mexico) were compared. The original cohort of the Hispanic EPESE included a total of 3,050 Mexican Americans aged ≥65 years. This cohort was selected through multistage area probability sampling of selected counties, blocks, and households, ensuring that the results could be generalizable to ~500,000 older Mexican Americans. Specific sampling procedures describing the Hispanic EPESE are available elsewhere (15). The response rate in 1993–1994 was 83%. Of that sample, a total of 1,132 subjects were aged ≥75 years. In the fifth wave conducted in 2004–2005, a

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new sample of 902 respondents aged ≥75 years was added, using sampling procedures similar to those used in 1993–1994. Interviews were conducted in English and Spanish, depending on the subjects' preference. Our study included subjects both from the original cohort in 1993–1994 and from the new cohort in 2004–2005 who were aged ≥75 years. This process resulted in two independent samples of Mexican Americans aged ≥75 years for analyses.

Table 1—*Descriptive characteristics of total sample by time period (unweighted frequencies and weighted percents)*

	1993/1994		2004/2005		
	n	%	*n*	%	*P*
n		1,132		902	
Age (years)*	1,132	81.0 (80.7–81.3)	902	81.4 (80.1–81.7)	0.357
Education (years)*	1,109	4.3 (4.1–4.5)	902	5.3 (4.7–5.3)	0.003
Female sex	662	58.4	531	59.6	0.639
Physician visits*	1,070	6.6 (6.1–7.2)	881	7.4 (6.7–8.0)	0.708
Type of insurance					
No insurance	71	7.4	52	5.8	
Medicare only	438	37.4	249	28.8	0.049
Medicare and Medicaid or Medicaid only	438	38.2	388	40.0	
Private and Medicare	185	17.0	213	25.4	
BMI					
<25 kg/m^2	383	38.5	243	32.1	
25–29 kg/m^2	368	41.2	287	39.0	0.007
≥30 kg/m^2	225	20.3	187	28.9	
Self-report hypertension	394	36.6	503	56.7	<0.001

Data are *n* or % unless indicated otherwise. $n = 2{,}030$. The *n* presented is the sample *n* due to missing data. *Data are means (95% CI).

Measurement of diabetes

Respondents were coded as having diabetes in 1993–1994 and 2004–2005 if they reported that they had been told by a doctor that they had diabetes, sugar in their urine, or high blood glucose or if they were found to be taking hypoglycemic drugs in an inspection of the medications they had taken in the 2 weeks before the interview.

Diabetes-related complications

Diabetes-related complications examined were microvascular complications, including kidney disease and visual impairment, and macrovascular complications, including circulatory disease and peripheral circulatory problems. Functional disability was also assessed. Kidney disease was determined by the following question: "As a result of your diabetes, have you ever had any problems with your kidneys?" Visual impairment was determined by the following question: "As a result of your diabetes, have you ever had any problems with your eyes?" Peripheral circulatory disease was determined by the following question: "As a result of your diabetes, have you ever had any problems with the circulation in your legs or arms?" Subjects were determined to have cardiovascular disease if they reported ever having a heart attack or a stroke.

Functional disability was ascertained through several self-reported variables. Lower-extremity function was measured by walking in a small room, walking a half-mile, walking up and down stairs, and transferring from bed to a chair. These items were examined separately and also summed to form a dichotomous variable indicating any lower-body disability. Also available was a measure of activities of daily living (ADL), which assessed disability by asking the subjects if they needed assistance with one or more of the following tasks: bathing, grooming, dressing, eating, transferring, or toileting. Instrumental activities of daily living (IADL) disability was assessed by asking the respondents if they needed assistance with one or more of the following tasks: using a telephone, driving, shopping, preparing meals, doing light housework, taking medicine, or handling money. Both ADL and IADL disability were dichotomized, indicating any ADL and IADL disability separately.

Demographic and health-related characteristics

Other covariates included in the analyses were age, years of education, sex, obesity, hypertension, and number of physicians' visits in the past year. Age was dichotomized as 75–79 years and ≥80 years. Self-reported hypertension was measured by asking whether a physician had ever told the respondents that they had high blood pressure. BMI was calculated from the respondent's measured height and weight. BMI was categorized as ≤24, 25–29, and ≥30 kg/m^2. Number of physician visits in the year before the interview was assessed by standard questions.

Statistical methods

Descriptive analyses of the sample were conducted using means and 95% CIs for continuous variables and proportions for categorical variables. Comparisons were made using the Rao-Scott χ^2 test for categorical variables and *t* test statistics for continuous variables. Diabetes prevalence and the prevalence of diabetes-related complications and functional disability were estimated in both cohorts and compared using the Rao-Scott χ^2 test. We used SAS (version 9.2) survey procedures software to perform all analyses to account for design effects and sample weights.

RESULTS

Descriptive characteristics of the samples in 1993–1994 and 2004–2005

Table 1 presents the descriptive characteristics of the full sample of Mexican Americans aged ≥75 years in both 1993–1994 and 2004–2005. The average educational attainment increased significantly between the two samples from 4.3 years in the original cohort to 5.3 years in the new cohort ($P = 0.003$). There was a significant increase in the number of individuals with Medicare and private insurance from 17.0 to 25.4% ($P = 0.049$). Obesity rates also increased between 1993–1994 and 2004–2005 from 20.3 to 28.9% ($P = 0.001$). Moreover, self-reported hypertension increased significantly between the two cohorts from 36.6 to 56.7%, respectively ($P < 0.001$). Characteristics such as age, sex, and physicians' visits did not change significantly between the two time periods.

Table 2—*Prevalence of diabetes by demographic and health-related characteristics in 1993/1994 and 2004/2005 (unweighted frequencies and weighted percents),* n *= 2,034*

	1993/1994		2004/2005			
	n	% (95% CI)	*n*	% (95% CI)	Difference % (95% CI)	*P*
	1,132		902			
Overall	242/1,132	20.3 (17.0–23.6)	324/902	37.2 (32.9–41.6)	17.0 (11.5–22.4)	<0.001
Sex						
Male	100/469	20.2 (15.5–24.8)	122/371	34.5 (28.4–40.7)	14.3 (6.6–22.0)	<0.001
Female	142/660	20.3 (16.0–24.7)	202/530	39.1 (33.8–44.4)	18.7 (11.9–25.6)	<0.001
Age						
75–79 years	116/520	20.8 (16.2–25.4)	157/399	39.7 (33.4–46.0)	18.9 (11.1–26.7)	<0.001
≥80 years	126/609	19.8 (15.4–24.3)	167/502	35.1 (29.7–40.5)	15.2 (8.2–22.2)	<0.001
Education						
0–6 years	187/855	20.3 (16.4–24.2)	224/604	39.5 (35.2–43.8)	19.2 (13.4–25.1)	<0.001
≥7 years	52/251	21.6 (15.0–28.3)	100/397	33.0 (25.8–40.2)	11.3 (1.48–21.1)	0.022
Physician visits						
0–1 visits	23/227	9.5 (4.9–14.0)	*20/123	21.0 (13.1–29.0)*	11.6 (2.4–20.7)	0.006
2–4 visits	60/317	19.4 (13.8–25.1)	99/320	32.3 (25.2–39.3)	12.8 (3.8–21.9)	0.003
≥5 visits	151/525	26.2 (20.7–31.7)	202/437	47.5 (41.0–51.1)	21.3 (12.8–29.9)	<0.001
Type of insurance						
No insurance	11/70	16.8 (4.3–29.4)	13/52	27.3 (14.4–40.3)	10.5 (−7.6–28.5)	0.260
Medicare only	87/437	17.9 (13.6–22.2)	85/248	35.6 (26.9–44.4)	17.7 (8.0–27.4)	<0.001
Medicare and/or Medicaid only	101/437	23.4 (17.6–29.1)	158/388	41.6 (36.3–46.9)	18.2 (10.4–26.0)	<0.001
Private and Medicare	43/185	20.1 (12.5–27.7)	68/213	34.5 (26.4–42.6)	14.4 (3.3–25.5)	0.006
BMI						
<25 kg/m^2	65/383	18.8 (13.0–24.6)*	61/243	23.6 (17.5–29.6)*	4.8 (−3.6–13.2)	0.271
25–29 kg/m^2	74/368	16.9 (12.1–21.7)	111/287	40.3 (33.1–47.4)	23.4 (14.7–32.0)	<0.001
≥30 kg/m^2	63/225	27.3 (21.2–33.5)	83/186	46.9 (38.2–55.6)	19.6 (8.9–30.2)	0.001
Self-reported hypertension						
Yes	113/394	25.3 (20.5–32.0)*	274/503	46.4 (40.4–52.4)*	20.1 (11.8–28.4)	<0.001
No	118/697	16.4 (12.7–20.1)	87/382	25.1 (20.3–29.9)	8.7 (2.7–14.8)	0.002

Data are *n* or % (95% CI). *Significant difference between all covariate strata in each cohort ($P < 0.05$).

Prevalence of diabetes

Table 2 presents the prevalence rate of diabetes at each time period as well as the prevalence of diabetes within the covariate strata. The overall prevalence of diabetes increased from 20.3% in 1993–1994 to 37.2% in 2004–2005 ($P < 0.001$). Moreover, the prevalence of diabetes has uniformly increased across all demographic characteristics, which include sex, age, and education subgroups. For example, the increase in diabetes prevalence was statistically significant for each age category. An 18.9 (95% CI 11.1–26.7) percentage point increase was observed in subjects aged 75–79 years and a 15.2 (8.2–22.2) percentage point increase was observed for subjects aged ≥80 years between these periods.

The prevalence of diabetes increased since 1993–1994 regardless of health care usage represented by physicians' visits, health insurance, BMI, and self-reported hypertension. Specifically, the prevalence of diabetes increased across all categories of physicians' visits, with the largest increase occurring in the five or more visits category from 26.2% (95% CI 20.7–31.7) in 1993–1994 to 47.5% (41.0–54.1) in 2004–2005 ($P < 0.001$). Similarly, the prevalence of diabetes increased across all types of insurance with the largest increase in prevalence of diabetes among those with Medicare and Medicaid or Medicaid only ($P < 0.001$). The prevalence of diabetes among overweight (BMI 25–29 kg/m^2) Mexican Americans more than doubled from 16.9% in 1993–1994 to 40.3% in 2004–2005 ($P < 0.001$). The prevalence of diabetes among obese (BMI ≥30 kg/m^2) Mexican Americans almost doubled from 27.3% in 1993–1994 to 46.9% in 2004–2005 ($P < 0.001$).

In addition, Table 2 shows prevalence rates within each covariate strata and sample year. In both cohorts significant differences in the prevalence of diabetes were shown for obesity and self-reported hypertension. In 1993–1994 the prevalence of diabetes was higher among obese compared with nonobese subjects (27.3 and 17.8%, respectively). A similar pattern was also present in 2004–2005. In addition, in the 1993–1994 cohort the prevalence of diabetes among those who reported hypertension was higher compared with that for those who did not report hypertension (25.3 and 16.4%, respectively). This pattern was echoed in 2004–2005.

Prevalence of diabetes-related complications and disability

Table 3 indicates the prevalence of diabetes-related complications and functional disability among Mexican Americans in both cohorts. The mean age of the 1993–1994 cohort was 80.4 (95% CI 79.9–81.0) and in the 2004–2005 cohort the mean age was 80.5 (80.0–80.9). No statistically significant differences were found between the two cohorts; therefore, the estimates of diabetes-related complications were not age adjusted. None of the microvascular or macrovascular complications significantly increased between the two time periods. On the other hand, having any lower-extremity functional

Table 3—Prevalence of diabetes-related complications and disability among Mexican Americans with diabetes aged ≥75 years in 1993/1994 and 2004/2005 (unweighted frequencies and weighted percents)

	1993/1994		2004/2005			
	n	% (95% CI)	*n*	% (95% CI)	Difference % (95% CI)	*P*
Microvascular complications						
Any complication	135/220	57.7 (48.9–66.6)	170/320	51.3 (43.2–59.4)	−6.5 (−18.5 to 5.6)	0.292
Kidney disease	29/218	13.9 (7.4–20.4)	44/314	14.6 (9.3–19.9)	0.75 (−7.6 to 9.1)	0.861
Visual impairment	85/213	38.3 (29.6–46.9)	113/312	36.4 (29.9–42.9)	−1.86 (−12.7 to 9.0)	0.735
Macrovascular complications						
Circulatory disease	92/215	39.2 (30.9–47.5)	128/305	40.5 (31.0–50.0)	1.31 (−11.3 to 14.0)	0.838
Cardiovascular disease	71/240	28.0 (21.7–34.2)	80/319	27.1 (19.8–34.4)	−0.87 (−8.8 to 10.5)	0.859
Self-report functional disability						
Walking	52/240	22.1 (15.2–28.9)	101/323	32.2 (24.1–40.3)	10.2 (−0.048 to 20.8)	0.056
Walking half-mile	107/235	39.3 (30.6–47.9)	135/317	43.2 (35.4–50.9)	3.9 (7.7 to 15.6)	0.508
Walking upstairs	114/238	47.2 (39.2–55.2)	134/319	43.2 (36.0–50.4)	4.0 (6.7 to 14.8)	0.456
Transferring from bed	38/240	15.4 (9.8–21.1)	110/323	32.2 (23.0–41.5)	16.8 (6.0 to 27.6)	0.005
Any lower-extremity disability	181/235	75.2 (66.9–83.6)	267/319	85.0 (80.1–89.9)	9.8 (0.013 to 19.4)	0.031
Global functional disability						
ADL disability	75/241	29.5 (22.1–36.9)	141/324	41.5 (31.9–51.2)	12.1 (−0.010 to 24.2)	0.047
IADL disability	182/242	77.3 (69.6–85.0)	263/324	80.2 (72.5–88.0)	2.9 (−8.0 to 13.8)	0.284

Data are *n* or % (95% CI). $n = 566$.

disability ($P = 0.031$), transferring from bed ($P = 0.005$), and ADL disability increased among individuals with diabetes ($P = 0.047$).

CONCLUSIONS— This is the first study that examined trends of diabetes and diabetes-related complications among Mexican Americans aged ≥75 years. The prevalence of diabetes in this sample increased from 20.3% in 1993–1994 to 37.2% in 2004–2005. The prevalence of both microvascular and macrovascular diabetes complications and IADL disability did not change significantly between the two cohorts. However, the prevalence of having any lower-extremity disability did increase between the two cohorts. In addition, self-reported ADL disability also significantly increased among individuals with diabetes between the two time periods.

Our findings are consistent with previous reports showing a national continuous upward trend in diabetes prevalence over the previous decade. Reports from the Centers for Disease Control and Prevention have shown that the prevalence of diabetes among the general population aged ≥75 years increased from 10.4% in 1993 to 16.4% in 2005 (1). Using the National Health Interview Survey (NHIS), the Centers for Disease Control and Prevention estimated the prevalence of diabetes among Mexican Americans aged ≥75 years in 2005 to be 28.5% (SEM 3.6), which was somewhat lower than our estimate of 37% for 2004–2005 (2.2) (1).

Our data show no significant changes in diabetes-related visual impairment among individuals with diabetes over the period from 1993–1994 to 2004–2005. This is consistent with national findings from the NHIS indicating a nonsignificant change in visual impairment rates among individuals with diabetes aged ≥75 years from 32.4% (SEM 2.0) in 1997 to 27.1% (1.4) in 2007 (1). Studies report a decrease in diabetes-related visual problems between the 1980s and the beginning of the 21st century resulting from improvements in screening and glycemic control (6). This improvement may not be apparent in our study because of differences in study periods compared with other studies, the advanced age of our sample, and measures used.

Although no prevalence data for diabetes-related kidney problems have been reported, findings from the U.S. Renal Data System showed that incidence rate of end-stage renal disease (ESRD) among individuals with diabetes aged ≥75 years has increased significantly over the period from 1997 to 2002, whereas it decreased among those aged ≥65 years (16). It is important to consider that our estimates measure any kidney disease related to diabetes, not ESRD specifically. The increase shown in ESRD presented in previous reports among those aged ≥75 years is again probably due to the increased survival of individuals with diabetes. Moreover, it could also reflect a concomitant increase in referral, admission rates, and intervention rather than an actual increase in ESRD incidence (6).

Similar to the trends in microvascular complications, we did not find significant changes in the prevalence of macrovascular complications including cardiovascular disease and peripheral circulatory problems. These findings are similar to reports from the NHIS showing no significant changes in the prevalence of any cardiovascular disease among the general population aged ≥75 years over the period from 1997 to 2003 (1). Because macrovascular conditions are not strongly related to hyperglycemia, improvement in diabetes management might not modify the prevalence of these conditions among individuals with diabetes (17).

The higher prevalence of diabetes reported in this study might be partly due to changes in the diagnostic criteria. The cutoff point in glycemia for a diagnosis of diabetes was decreased from ≥140 to ≥126 mg/dl in 1997 (18). This reduction may have had a substantial influence on the recent prevalence estimates for diabetes. The new diagnostic criteria are probably capturing individuals with diabetes at an earlier point in the disease. Reports have suggested that widespread use of the new criteria are capturing many individuals with undiagnosed diabetes, which may result in even higher prevalence estimates (18).

Another explanation for the upward trend in diabetes is the concurrent increase in obesity in older Mexican Americans. As we have shown above, the prevalence of obesity has increased dramatically in this older population since the baseline interview in 1993–1994. Obesity is reported to be one of the most significant factors contributing to the development of diabetes and is highly prevalent in Hispanic populations (19).

Mexican Americans are living longer but are living with more chronic conditions and more disability (9). Older adults with diabetes are more likely to have functional disabilities and are more likely to use mobility aids compared with individuals without diabetes (20). Consequently, more functional disability among individuals with diabetes could also lead to an overall reduction in active life expectancy.

Active life expectancy is an important consideration because the prevalence of diabetes has dramatically increased among Mexican Americans aged ≥75 years. It has been found that individuals with diabetes aged ≥75 years in the U.K. have experienced a significant reduction in active life expectancy in recent years, where individuals without diabetes had an extra 2 years of life without disability compared with individuals with diabetes in 1999 (21). Similarly, a study consisting of older adults aged ≥65 years showed that those who do not have diabetes gain between 4 and 5 disability-free years of life (22). Both diabetes and obesity contribute to a reduction in functional ability. Older adults who are obese are more likely to become disabled and, generally speaking, older adults are also less likely to recover compared with younger obese individuals (23). As Mexican Americans age, specific attention to the pathways leading to this increase in obesity such as the reduction of adipose tissue in the abdominal area and dietary modifications could reduce functional disability and increase future active life expectancy.

There are several limitations to this study. The determination of a diabetes diagnosis was based on a self-reported measure and was not based on any clinical measure of fasting plasma glucose. In addition, the presence of diabetes-related complications was also based on self-report. However, these types of self-reported measures have been found to be a valid and reliable method of determining the presence of disease (24). Nevertheless, underreporting may have occurred by not including those in whom diabetes has not yet been diagnosed, but who actually have the disease. In the U.S., it is estimated that there are 2.4 million individuals with undiagnosed diabetes. Moreover, many diagnoses are incidental and only occur when related complications emerge. New onset of diabetes in older individuals is not very common, meaning that oftentimes diabetes goes undiagnosed while other complications arise (25).

In summary, in light of the high prevalence of diabetes in this group, no improvement in diabetes-related complications heightens the urgency for public health interventions. As diabetes is projected to become more prevalent in older adults in the future (2), physicians need to be trained in early detection of diabetes among older adults and should encourage appropriate management in patients aged ≥75 years, including glycemic control and healthier lifestyles and adequate pharmacological treatment when indicated. Moreover, common clinical and physiological pathways between obesity and diabetes may allow the development of interventions that might improve diabetes-related complications and functional disability in this population.

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