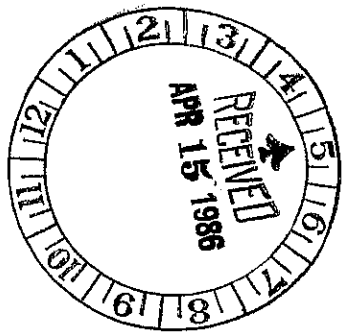
For Don Cardenas



CHAPTER IX. DIABETES IN HISPANIC AMERICANS

Michael P. Stern, M.D.

SUMMARY

There are about 15 million persons of Spanish origin in the United States. About 10-12 percent of Mexican American adults have diabetes, greater than 95 percent of which is the noninsulin-dependent type (NIDDM). A distinct socioeconomic gradient is present, with NIDDM being two to four times as common in low income (barrio) Mexican Americans as in upper income (suburban) Mexican Americans. Diabetes is about 2.8 times as frequent in Mexican American men as in all white men in the United States and about 1.5 times as frequent in Mexican American women as in all white women. Explanations for these differences in prevalence include higher rates of obesity in Mexican Americans, particularly women, lower family income, and higher percent of native American genetic admixture in Mexican Americans than in all whites in the United States.

In Puerto Rico, NIDDM prevalence is higher in urban than in rural residents, although the overall prevalence does not appear to be as high as in Mexican Americans. These differences do not appear to be due to differences in obesity, at least in urban dwellers. There do not appear to be any studies of diabetes prevalence in Puerto Ricans living in the United States or studies of Cuban Americans.

METHODOLOGY OF STUDIES OF DIABETES IN HISPANIC AMERICANS

The variable criteria used to define diabetes in studies on Hispanic Americans are problematic. Relatively few studies have used the new National Diabetes Data Group (NDDG) criteria. Even when NDDG criteria have been used, however, methodological differences between studies may have unexpectedly large effects on reported prevalence rates. Not all studies have distinguished between noninsulin-dependent diabetes (NIDDM) and insulin-dependent diabetes (IDDM). In this chapter, the term "diabetes" will be used when the two types have not been distinguished, and the terms "IDDM" and "NIDDM" will be used when these types are specifically referred to.

A further problem is how to classify patients who give a history of diabetes but who do not meet the NDDG criteria at the time they are studied. In this chapter, such pa-

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tients are considered to be diabetic only if they reported taking insulin or oral antidiabetic agents. This approach, however, could only be used when information on the use of antidiabetic medication was available. The rationale for this decision was that, since the new NDDG criteria are set higher than former criteria, it is possible that a number of persons who were diagnosed using former criteria would not now be considered to have diabetes. The policy that has been adopted requires that all patients meet NDDG criteria unless they were known to be taking hypoglycemic agents at the time of study.

There are only three published studies of diabetes prevalence in Mexican Americans, all conducted in southern Texas. Data on diabetes prevalence in Puerto Rico are also available, although there do not appear to be any studies of diabetes prevalence among Puerto Ricans living outside Puerto Rico or among Cuban Americans. Although diabetes is unquestionably a major cause of morbidity and mortality among Hispanic Americans, there is still a major need for additional studies to better define the magnitude and scope of this important health problem. The Hispanic Health and Nutrition Examination Survey (HHANES) now being conducted should provide new data on Mexican Americans, Puerto Ricans, and Cubans from multiple sites across the United States.

IDDM VERSUS NIDDM IN HISPANIC AMERICANS

The great majority of diabetics identified in population-based studies of adult Hispanic Americans are of the NIDDM type. In the San Antonio Heart Study, for example, while 15 of 142 Mexican American diabetics 25-64 years old were insulin takers, 9 of these 15 were considered on the basis of obesity (BMI greater than 30.0 kg/m^2) and/or age of onset (greater than 40 years) to have NIDDM despite their having been treated with insulin (Stern et al. 1984). Thus only 4 percent of Mexican American diabetics might possibly have been classified as having IDDM. In Starr County, Texas, all of the male diabetics and all but one of the 285 female diabetics in the age group 25-64 years had NIDDM (Hanis et al. 1983). There are no data available on IDDM rates in younger Hispanic Americans.

PREVALENCE OF NIDDM IN MEXICAN AMERICANS

Perhaps the earliest study of diabetes prevalence in Mexican Americans was carried out in Laredo, Texas, where 17 percent of persons ages 45 to 74 years were found to be diabetic (Table 1), either because they exhibited fasting plasma glucose values exceeding the NDDG criteria for diabetes (greater than or equal to 140 mg/dl) or because they were diagnosed diabetics on insulin or oral antidiabetic medication. Only about 15 percent of the diabetics were newly diagnosed, the remainder having been previously diagnosed as diabetic. This proportion is quite a bit lower than the proportion found in a later study in the San Antonio barrio (an area of socioeconomic status similar to Laredo) and may be due to the fact that OGTTs were not performed in Laredo. Since the sensitivity of the fasting plasma glucose in identifying the total number of diabetics meeting NDDG criteria may only be 59 percent (Haffner et al. 1984), it seems quite possible that there were a number of diabetics in Laredo who might have met the post-load glucose criteria but who were unidentified. The inclusion of such individuals would have generated higher rates of total diabetes and probably also a higher proportion of newly-diagnosed cases in Laredo.

Glucose tolerance tests were performed, however, in a later study conducted in San Antonio. Table 2 shows the prevalence of previously and newly diagnosed NIDDM in Mexican American men and women in San Antonio, and in a random sample of United

TABLE 1. *Prevalence (percent) of diabetes in Mexican Americans in Laredo, Texas, 1979*

Sex and Age (Years)	Previously Diagnosed*		Newly Diagnosed* (Fasting Hyperglycemia)		Total
	Number	Percent	Number	Percent	Percent
Men					
45-54	3/37	8.1	1/37	2.7	10.8
55-64	7/42	16.7	0/42	0	16.7
65-74	5/30	16.7	2/30	6.7	23.3
Total 45-74	15/109	13.8	3/109	2.8	16.5
Age-adjusted prevalence**		13.0		2.7	15.7
Women					
45-54	7/93	7.5	0/93	0	7.5
55-64	9/70	12.9	3/70	4.3	17.1
65-74	18/65	27.7	2/65	3.1	30.8
Total 45-74	34/228	14.9	5/228	2.2	17.1
Age-adjusted prevalence**		14.0		2.2	16.1

*Criteria for previously diagnosed diabetes were history of diabetes together with either fasting plasma glucose $\geq$ 140 mg/dl or currently using insulin or oral antidiabetic medication; criterion for newly diagnosed diabetes was fasting plasma glucose $\geq$ 140 mg/dl.

**Age-adjusted by the direct method to the United States 1970 population.

SOURCE: Stern, MP, et al. Cardiovascular risk factors in Mexican Americans in Laredo, Texas. Am J Epidemiol 113:546-555, 1981.

TABLE 2. *Prevalence (percent) of previously and newly diagnosed NIDDM in the San Antonio Heart Study of Mexican Americans, 1979-82, and the Second National Health and Nutrition Examination Survey (NHANES II) of the general United States population, 1976-80*

	San Antonio Age 25-64				NHANES II Whites, Age 20-64	
	Men (N = 551)		Women (N = 737)		Men	Women
	Number	Percent	Number	Percent	Percent	Percent
Previously diagnosed	25	4.5	34	4.6	2.1	3.2
Failed to meet NDDG criteria						
on oral agents	4	0.7	2	0.3		
on insulin	0	0	0	0		
Met NDDG criteria						
on diet only	8	1.5	9	1.2		
on oral agents	11	2.0	16	2.2		
on insulin	2	0.4	7	0.9		
Newly diagnosed*	39	7.1	38	5.2	2.0	3.1
Total	64	11.6	72	9.8	4.1	6.3
Newly diagnosed as percent of total diabetics		61		53	49	49

*All newly diagnosed cases met NDDG criteria for fasting glucose or OGTT values.

TABLE REFERENCES

a. San Antonio data: Haffner, SM, M Rosenthal, HP Hazuda, MP Stern, and LJ Franco. Evaluation of three potential screening tests for diabetes in a biethnic population. Diabetes Care 7:347-53, 1984; and unpublished data.

b. NHANES II data: Harris, MI, National Diabetes Data Group. Unpublished data.

States white men and women from the 1976-80 National Health and Nutrition Examination Survey (NHANES II). The Mexican American rates are consistently higher than the United States rates. Newly diagnosed cases accounted for 61 percent of total cases among Hispanic men and 53 percent among women; they accounted for 49 percent for both men and women in the NHANES II survey. Also shown in Table 2 are the proportion of previously diagnosed Hispanic cases who met the NDDG criteria and the proportions receiving various types of antidiabetic treatment. The proportion of NHANES II previously diagnosed cases that failed to meet NDDG criteria is not known.

Another study, using a somewhat different methodology for ascertaining undiagnosed diabetes, was conducted in Starr County, Texas (Table 3). Like the San Antonio Heart Study and NHANES II, the Starr County study based the diagnosis of newly discovered diabetes on an OGGT using the NDDG criteria. However, Starr County was designed

TABLE 3. *Prevalence (percent) of diabetes in Mexican Americans in Starr County, Texas, 1981*

Sex and Age (Years)	Previously Diagnosed*		Newly Diagnosed*		Total
	Number	Percent	Number	Percent	Percent
Men					
15-24	0/211	0	0/211	0	0
25-34	3/115	2.6	0/115	0	2.6
35-44	3/92	3.3	0/92	0	3.3
45-54	7/95	7.4	5/95	5.3	12.6
55-64	11/85	12.9	3/85	3.5	16.5
65-74	8/60	13.3	2/60	3.3	16.7
75+	4/34	11.8	2/34	5.8	17.6
Total 15-75	36/692	5.2	12/692	1.6	6.9
Age-adjusted prevalence (15-75 yrs)**		5.6		1.9	7.5
Age-adjusted prevalence (25-64 yrs)**		6.2		2.1	8.3
Women					
15-24	1/285	0.4	0/285	0	0.4
25-34	1/254	0.4	0/254	0	0.4
35-44	8/210	3.8	4/210	1.9	5.7
45-54	17/204	8.3	5/204	2.5	10.8
55-64	26/142	18.3	1/142	0.7	19.0
65-74	10/94	10.6	6/94	6.4	17.0
75+	3/50	6.0	1/50	2.0	8.0
Total 15-75	66/1,239	5.3	17/1,239	1.4	6.7
Age-adjusted prevalence (15-75 yrs)**		5.7		1.4	7.1
Age-adjusted prevalence (25-64 yrs)**		7.0		1.3	8.3

*Previously diagnosed diabetes defined as medical history of diabetes, or taking insulin or oral hypoglycemic drugs, or meeting NDDG criteria. Newly diagnosed diabetes defined as all of the following: casual blood glucose $\geq$130 mg/dl, 4-hour fasting blood glucose $\geq$130 mg/dl, and meeting NDDG criteria.

**Age-adjusted by the direct method to the United States 1970 population.

SOURCE: Hanis, CL, et al. Diabetes among Mexican Americans in Starr County, Texas. Am J Epidemiol 118:659-72, 1983.

primarily to identify diabetics for a family pedigree study, and two prescreen blood glucose determinations were used to select subjects for the full OGTT. Only subjects who had casual capillary whole blood glucose values greater than or equal to 130 mg/dl were selected for a subsequent 4-hour fasting capillary blood glucose determination. If this fasting value was also greater than or equal to 130 mg/dl (which is greater than the NDDG fasting criteria), glucose tolerance testing was scheduled. Hence ascertainment of undiagnosed diabetics in Starr County was similar to that in Laredo, in that in both a diagnosis of newly discovered diabetes was based primarily on fasting hyperglycemia, and persons with normal fasting values but who might have had abnormal OGTTs appear not to have been included. Thus, as in the Laredo study, the percent of diabetics who were newly diagnosed was markedly lower in Starr County than in San Antonio (20-25 percent versus 50-60 percent), and the rates of total diabetes in Starr County (Table 3) were substantially lower than in the San Antonio barrio (Table 4) (8 percent versus 14 percent for age 25-64 years). The comparison to the barrio is made because Starr County participants, like Laredo participants, were mainly of lower socioeconomic status and were therefore most comparable to San Antonio barrio residents (see below).

TABLE 4. *Prevalence of noninsulin-dependent diabetes mellitus (NIDDM)* in Mexican Americans according to socioeconomic status, the San Antonio Heart Study, 1979-82*

Sex and Age (Years)	Barrio		Transitional Neighborhood		Suburbs	
	Number	Percent	Number	Percent	Number	Percent
Men						
25-34	2/50	4.0	1/62	1.6	0/31	0
35-44	3/32	9.4	4/51	7.8	2/64	3.1
45-54	7/46	15.2	9/40	22.5	7/64	10.9
55-64	15/50	30.0	11/36	30.6	3/25	12.0
Total 25-64	27/178	15.2	25/189	13.2	12/184	6.5
Age-adjusted prevalence**		13.7		14.6		6.1
Women						
25-34	1/71	1.4	1/92	1.1	2/53	3.8
35-44	8/73	11.0	5/65	7.7	1/73	1.4
45-54	13/75	17.3	4/48	8.3	2/54	3.7
55-64	27/79	34.2	7/38	18.4	1/16	6.3
Total 25-64	49/298	16.4	17/243	7.0	6/196	3.1
Age-adjusted prevalence**		14.8		8.2		3.7

*NIDDM defined as cases meeting NDDG criteria for diabetes (fasting or OGTT criteria), or, for those persons who did not meet NDDG criteria, history of diabetes together with current use of insulin or oral antidiabetic agents.

**Age adjusted by the direct method to the United States 1970 population.

SOURCE: Stern, MP , M Rosenthal, SM Haffner, HP Hazuda, and LJ Franco. Sex difference in the effects of sociocultural status on diabetes and cardiovascular risk factors in Mexican Americans. Am J Epidemiol 120:834-51, 1984.

CORRELATION OF DIABETES PREVALENCE WITH SOCIOECONOMIC STATUS AND OBESITY

A distinct socioeconomic gradient for diabetes was found among San Antonio Mexican Americans. The prevalence of NIDDM was more than twice as high among barrio men as among the more affluent suburban men; the prevalence was four times as high among barrio women as among suburban women (Table 4). These results are correlated with the higher prevalence of obesity in the barrio, at least in women (Gardner et al. 1984). However, obesity cannot be the sole explanation for the socioeconomic differences in NIDDM prevalence among Mexican Americans. When lean, average, and obese Mexican Americans are compared to Anglos closely matched for adiposity, Mexican Americans still have from 2 to 3-1/2 times higher NIDDM prevalence than Anglos (Table 5). There is also evidence that the percent of native American genetic admixture (increasing stepwise from suburbs to barrio) may contribute to excess NIDDM prevalence among Mexican Americans (Gardner et al. 1984).

TABLE 5. *Prevalence of noninsulin-dependent diabetes mellitus (NIDDM) according to degree of adiposity, San Antonio Heart Study, 1979-82*

Adiposity Category	Men				Women			
	Mexican American		Anglo		Mexican American		Anglo	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Lean	7/87	8.0	1/55	1.8	2/83	2.4	0/73	0
Average	9/128	7.0	2/54	3.7	9/124	7.3	0/77	0
Obese	29/168	17.3	2/56	3.6	47/342	13.7	7/78	9.0
Mantel-Haenszel prevalence ratio	3.59 (p<0.005)				2.30 (p<0.025)			

SOURCE: Stern, MP, SP Gaskill, HP Hazuda, LI Gardner, and SM Haffner. Does obesity explain excess prevalence of diabetes among Mexican Americans? Results of the San Antonio Heart Study. Diabetologia 24:272-77, 1983.

DIABETES AMONG PUERTO RICANS

Diabetes prevalence rates from the Puerto Rico Heart Health Program are summarized in Table 6. In this study, which included men only, the rates of previously diagnosed and newly diagnosed diabetes were considerably higher among urban men than among rural men. Newly diagnosed cases accounted for 42 percent of all rural cases, but only 29 percent of urban cases. Comparing the rates in Puerto Rico to those recorded in San Antonio for corresponding age categories, it is apparent that the highest rates in Puerto Rico (those for urban men) approach the lowest rates in San Antonio (those for suburban men) (Table 4). The monthly income of the Puerto Rican urban men, however, was quite low (Garcia-Palmieri et al. 1970); thus their diabetes rates should be compared with the much higher San Antonio barrio rates. It is difficult to judge if these prevalence differences between Puerto Rico and San Antonio are real since the criteria used to diagnose diabetes in the Puerto Rico study were quite different from those used in the San Antonio Heart Study. In the Puerto Rico study, diabetes was diagnosed if the subject gave a history of this disease (cases treated by diet only were included, in contrast with the procedure followed in San Antonio) or if a casual whole blood glucose was greater than or equal to 140 mg/dl (equivalent to a

plasma glucose of 160 mg/dl) by the Somogyi-Nelson method. Although this value is higher than the NDDG fasting cutoff of 140 mg/dl, which would tend to lower the prevalence estimates, the specimens were casual rather than fasting, and the Puerto Rico criteria included cases treated with diet only rather than only those who were receiving antidiabetic medication. Both of these latter procedural differences would tend to raise the prevalence estimates relative to the San Antonio estimates.

Table 6 shows the prevalence of diabetes in Puerto Rican men according to relative weight. As expected, the prevalence rates rose progressively with increasing relative weight both in rural and urban men. Interestingly, at any given relative weight the prevalence of diabetes was higher in urban than in rural men, indicating that although obesity no doubt plays a role in the rural-urban differences, other factors must also be involved. The relative weights in the Puerto Rican Study averaged 1.04 for rural and

TABLE 6. *Prevalence (percent) of previously and newly diagnosed diabetes in Puerto Rican men ages 45 to 64, Puerto Rico Heart Health Program, 1965*

	Rural Men		Urban Men	
	Number	Percent	Number	Percent
Diabetic status				
Previously diagnosed				
Euglycemic		1.3		3.6
Hyperglycemic		0.8		2.8
Newly diagnosed		1.5		2.6
Total		3.6		9.0
Age (years)				
45-49	16/552	2.9	113/1,683	6.7
50-54	24/735	3.3	174/1,935	9.0
55-59	22/684	3.2	134/1,427	9.4
60-64	31/596	5.2	134/1,145	11.7
Total 45-64	93/2,567	3.6	555/6,190	9.0
Age-adjusted prevalence*		3.5		9.0
Relative weight**				
Ages 45-54				
<100	8/545	1.5	21/604	3.5
100-109	2/303	0.7	29/593	4.9
110-125	13/302	4.3	121/1,374	8.8
>125	17/135	12.6	115/1,042	11.0
Ages 55-64				
<100	10/630	1.6	28/592	4.7
100-109	7/279	2.5	40/448	8.9
110-125	23/254	9.1	107/870	12.3
>125	13/115	11.3	93/659	14.1

*Age-adjusted by the direct method to the United States 1970 population.

**Percent of ideal body weight for observed height from Metropolitan Life Insurance tables.

SOURCE: Cruz-Vidal, M, et al. Factors related to diabetes mellitus in Puerto Rican men. Diabetes 28:300-07, 1979.

1.16 for urban men (Cruz-Vidal et al. 1979). In San Antonio, the corresponding figures were 1.12 for barrio men and 1.10 for suburban men. These data suggest that relative leanness might in part explain the lower rates among rural Puerto Ricans relative to barrio San Antonio residents, but not among urban dwellers.

MORTALITY AMONG HISPANIC AMERICANS

Diabetes appears to be a more frequent cause of death among Hispanic Americans than among the general United States population. For example, in Bexar County, Texas (which contains San Antonio), although age-adjusted mortality due to diabetes declined from 1970 to 1976 in both Spanish and non-Spanish surname residents, the rates were consistently two to four times higher in the former than in the latter for both men and women (Figure 1). In the state of Texas in 1970-81, diabetes accounted

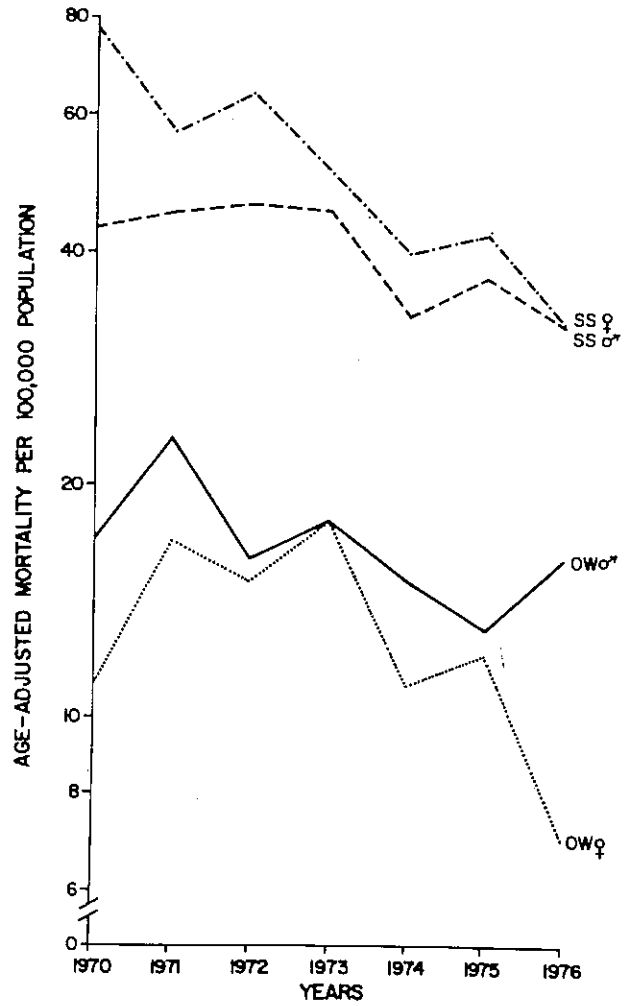

FIGURE 1. *Secular trends in age-adjusted diabetes mortality (ICDA code 250) in Bexar County, Texas from 1970-76 by sex and ethnic group. SS=Spanish surname, OW=other whites.*

SOURCE: Stern, MP, and SP Gaskill. Secular trends in ischemic heart disease and stroke mortality. Circulation 58:537-43, 1978.

for 18.2 per 1,000 deaths, but this proportionate mortality rate in specific counties was highly correlated with the percent of county residents who had Spanish surnames (predominently Mexican American) (Table 7).

TABLE 7. *Diabetes proportionate mortality and percent Spanish origin of residents, Texas, 1970-81*

Area	Diabetes Deaths Per 1,000 Deaths	Percent of Area Residents of Spanish Origin
Texas (state)	18.2	15.4-15.7
Counties		
Starr	52.0	97.9
LaSalle	51.6	78.4
Brooks	45.6	79.9
Webb	43.6	85.6
Maverick	35.5	90.3
Haskell	34.1	13.0
Kleberg	32.1	43.9
Hidalgo	31.5	79.1
Dimmit	31.1	81.7
Mitchell	30.8	24.7
Blanco	8.9	11.2
Brewster	8.3	47.8
Clay	8.3	<5.0
Kendall	7.9	20.3
Brown	7.8	5.4
Red River	7.5	<2.8
Deaf Smith	5.8	36.3
Archer	5.7	<6.9
Somervell	3.8	14.3
Dallam	2.5	17.5

SOURCE: Hanis CL, RE Ferrel, SA Barton, et al. Diabetes among Mexican Americans in Starr County, Texas. Am J Epidemiol 118:659-72, 1983.

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APPENDIX A. *Percent of diagnosed diabetes in Hispanic Americans and the general United States population, 1976*

Age (Years)	All Persons	Hispanic Persons
All ages	2.20	2.13
0-44	0.58	0.54
45-64	4.53	8.48
65-74	8.38	13.44

SOURCE: Harris, MI, and T Drury, National Diabetes Data Group. Unpublished data from the 1976 National Health Interview Survey, National Center for Health Statistics.

APPENDIX B. *Hispanic American population figures*

Hispanic Americans are the second largest and fastest growing minority group in the United States. In 1970, the Hispanic population represented 4.5 percent (9.07 million persons) of the total United States population. In 1980, these figures had grown to 6.4 percent (14.6 million persons). In 1980, nearly 90 percent of United States Hispanics resided in metropolitan areas. More than 3.5 million, or almost one-fourth of all the Hispanics in the country, lived in the Los Angeles and New York City areas alone. The 10 metropolitan areas with the most Hispanics in 1980 were:

Los Angeles-Long Beach, Calif.	2,065,727
New York City-N.J.	1,493,081
Miami, Fla.	581,030
Chicago, Ill.	580,592
San Antonio, Tex.	481,511
Houston, Tex.	424,901
San Francisco-Oakland, Calif.	351,915
El Paso, Tex.	297,001
Riverside-San Bernadino-Ontario, Calif.	289,791
Anaheim-Santa Ana-Garden Grove, Calif.	286,331

SOURCE: U.S. Bureau of the Census.

APPENDIX C. *Spanish origin population of the United States, 1980*

Age (Years)	Males	Females	Age (Years)	Males	Females
All ages	7,278,259	7,327,624	45-49	300,175	321,343
<5	847,860	814,932	50-54	270,030	294,198
5-9	782,641	754,254	55-59	217,123	237,237
10-14	746,936	727,901	60-64	147,184	173,730
15-19	826,449	779,378	65-69	115,542	148,156
20-24	819,158	766,493	70-74	84,748	108,668
25-29	697,098	678,431	75-79	58,927	77,449
30-34	558,146	570,201	80-84	27,371	39,094
35-39	415,640	438,419	85+	18,557	30,273
40-44	344,674	367,467	Median age	22.7	23.8

SOURCE: Bureau of the Census. Age, sex, race, and Spanish origin of the population. Supplementary report PC 80-51-1, May 1981.

APPENDIX D. *Number of persons (thousands) and percent with Hispanic origin among diabetics and the general population age 20 years and older, United States, 1979-81*

	Age (Years)							
	20+		20-44		45-64		65+	
	General Population	Diabetics	General Population	Diabetics	General Population	Diabetics	General Population	Diabetics
Both sexes								
Total number of persons*	148,262	5,317	80,810	804	43,529	2,400	23,924	2,112
Number of Hispanic origin	9,044	321	6,061	60	2,176	197	766	64
Percent of Hispanic origin	6.1	6.0	7.5	7.4	5.0	8.2	3.2	3.0
Men								
Total number of men*	69,756	2,306	39,180	326	20,746	1,145	9,830	836
Number of Hispanic origin	4,255	124	2,899	27	1,037	77	315	20
Percent of Hispanic origin	6.1	5.4	7.4	8.3	5.0	6.7	3.2	2.4
Women								
Total number of women*	78,506	3,011	41,630	479	22,782	1,256	14,094	1,276
Number of Hispanic origin	4,710	197	3,122	33	1,139	120	437	44
Percent of Hispanic origin	6.0	6.5	7.5	6.9	5.0	9.6	3.1	3.4

*Excludes persons with unknown origin.

SOURCE: Computed by the Division of Epidemiology and Health Promotion from 1979-81 National Health Interview Survey data provided by the Division of Health Interview Statistics, National Center for Health Statistics.