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DIABETES, DIABETES COMPLICATIONS, AND THEIR CONSEQUENCES IN MEXICAN-AMERICAN ELDERS

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DIABETES, DIABETES COMPLICATIONS, AND THEIR CONSEQUENCES IN MEXICAN-AMERICAN ELDERS

by

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Dedication

To my mother Eva Rosa Otiniano for her understanding and support during these years of education

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DIABETES, DIABETES COMPLICATIONS, AND THEIR CONSEQUENCES IN MEXICAN-AMERICAN ELDERS

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The **purpose** of this study is to describe the epidemiology of diabetes, diabetes complications and their consequences over an 11-year period in Mexican-American elders. **Design:** This is an 11-year prospective cohort study (1993-1994 to 2004-2005). **Setting:** This study was conducted among residents of five southwestern states: Texas, New Mexico, Colorado, Arizona, and California. **Participants:** This is a population-based sample of 3050 non-institutionalized Mexican American men and women aged 65 or older from the Hispanic Established Population for Epidemiologic Studies of the Elderly (H EPESE). **Measures:** A number of measures were developed that include socio demographic indicators; categories of health behaviors; and self-reports of diabetes, diabetes complications, functional disability, medical conditions, health service utilization, and depressive symptoms. Self-reported heart attack, self-reported stroke, mortality, and HbA_1c measure were used as independent variables over the 11-year period. **Results:** 1) The estimated prevalence of diabetes was 22%. 2) The estimated prevalence of diabetic complications was 60% (retinopathy: 38%, nephropathy: 14%, peripheral vascular disease: 40%, and amputations: 8%). 3) Self-reported heart attack and self-reported stroke are significantly associated with diabetes at 7-year follow-up. 4) At 7-year follow-up, heart attack accounted for 45% of deaths in diabetics. 5) At 11-year follow-up, glycemic control was associated with low education, duration of disease, and severity of disease. **Conclusions:** These findings suggest that Mexican American elders with diabetes are at high risk of developing diabetes complications, primarily heart attack, stroke, and premature mortality. It is important to promote educational programs aimed at developing healthy lifestyle changes beginning in early adulthood as a preventive measure to delay the onset of disease in this high risk population.

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Chapter 1: Specific Aims

The purpose of this study is to describe the epidemiology of diabetes, diabetes complications and their consequences in Mexican-American elders from the Hispanic Established Populations Epidemiologic Study of the Elderly (Hispanic EPESE). Diabetes will be discussed in terms of self-reported physician diagnosed diabetes, diabetes complications in terms of self-reported problems with the eyes (retinopathy); self-reported problems with the kidney (nephropathy); self-reported problems with circulation in legs or arms (peripheral vascular disease); and self-reported loss of limb by amputation as a result of diabetes. Consequences of diabetes will be discussed on terms of self-reported physician diagnosis of heart attack and stroke. Mortality will be discussed in terms of information gathered from interviews with proxy-respondents or a search performed by either the Epidemiology Resources, Inc. (ERI) or by the National Death Index (NDI).

The primary aim is to examine the prevalence and correlates of diabetes among Mexican American elders. The primary aim has two hypotheses. Hypothesis 1.a. posits that female elders have greater prevalence of diabetes compared to male elders. Hypothesis 1.b. posits that poor socioeconomic status measured by low education level and low household income will be associated with diabetes.

The secondary aim is to examine the prevalence and correlates of diabetic complications (retinopathy, nephropathy, peripheral vascular disease, and amputations) among Mexican American elders. The secondary aim has two hypotheses. Hypothesis 2.a posits that age will be associated with more diabetic complications. Hypothesis 2.b. posits that length of the disease will be associated with more diabetic complications.

The third aim is to examine the association between diabetes and 7-year incidence of cardiovascular disease (heart attack and stroke) among Mexican Americans elders. The third aim has two hypotheses. Hypothesis 3.a. posits that Mexican American elders with diabetes experience high incidence of heart attack compared to Mexican American elders without diabetes. Hypothesis 3.b. posits that Mexican American elders with diabetes experience high incidence of stroke compared to Mexican American elders without diabetes.

The fourth aim is to examine the association between diabetes and 7-year mortality among Mexican American elders. It is hypothesized that among diabetics, high number of diabetic complications will be associated with an increased risk of mortality.

The fifth aim is to examine the factors associated with glycemic control (HbA_1c measure). It is hypothesized that poor glycemic control will be associated with severity of the disease.

Data employed are from the Hispanic EPESE, a study in compliance with the requirements of the University of Texas Medical Branch (UTMB) Institutional Review Board/Human Subjects Research Committee. The Hispanic EPESE is an ongoing National Institute on Aging (NIA) funded community-based study that provides basic information on the health status and health care needs of 3050 Mexican Americans aged 65 and older. The Hispanic EPESE, modeled after previous Established Populations for Epidemiological Study of the Elderly studies conducted in New Haven, East Boston, North Carolina, and rural Iowa, contains information on 3050 older Mexican Americans from five Southwestern states (Arizona, California, Colorado, New Mexico, and Texas).

SIGNIFICANCE OF RESEARCH

Diabetes and its complications in aged Mexican Americans have significant long-term health consequences with the potential for many chronic and disabling complications. The effect of diabetes and related complications on health outcomes has not been systematically examined in the Mexican American elder population, particularly for long-term follow-up and in combination with other risk factors. Diabetes is the sixth leading cause of death in the United States, and complications such as retinopathy, kidney disease, and amputations cause a huge burden to the national care system. The life expectancy for persons with diabetes is approximately 15 years less than those who do not have diabetes (1). Amputations, nephropathies, blindness, and other complications affect diabetics severely and cause devastating disability. Diabetes is a treatable disease and most complications are preventable.

Findings from the proposed study will provide an understanding of the impact of diabetes, complications such as retinopathy, nephropathy, peripheral vascular disease, and amputations, and their consequences such as heart attack and stroke in an aged Mexican American population over a 7-year follow-up. These findings will be very interesting because the uniqueness of a Hispanic sub sample population, the age group of the population studied, and the number of years that this population was followed up. The findings will serve as a base to future studies of diabetes in Mexican American elders, as well as studies of other Hispanic subgroups.

This research study is important because the information obtained will improve understanding of this major public health problem. The study has implications for young Mexican Americans with diabetes in terms of educating them about lifestyle changes and about control of the disease and prevention of its complications. This type of research is needed to understand the contribution of risk factors to intervene in reducing diabetes complications and mortality to avoid the burden of disease and inequalities in health, as evidenced by the gaps in the severity of the disease that affect this segment of the population.

Furthermore, this study will help us to understand the severity of this disease and how complications and other related factors affect function and mortality. We will learn how glycemic control will contribute to decrease and delay the onset of complications.

The United States is aging on par with other developed and industrialized countries. The Hispanic population living in the United States is increasing dramatically and diabetes may reach an epidemic proportion that must be addressed. We have to know more about diabetes in Mexican American and other Hispanic subgroups affected with the disease to better develop new preventive measures, to promote education, and to affect lifestyle changes.

Finally, the Hispanic EPESE is a unique data source that is representative of over 500,000 elderly Mexican Americans in the Southwest United States (2). It is comparable to the other EPESE surveys; therefore, this study can provide the potential for ancillary studies such as the "Hispanic Paradox" to understand the health advantage of Mexican Americans relative to Whites or other minorities groups, despite the fact that many of them live in relatively poor social or economic conditions (3).

CHAPTER 2: BACKGROUND

Chapter 2 is organized into 3 sections. The first section is an overview of issues related to aging in the United States as well as issues relevant to Mexican Americans. The second section presents an overview of diabetes, including definition, types, genetic predisposition, access and barriers, prevalence, incidence, and risk factors. The third section is an overview of complications, consequences, treatment and prevention.

In 2003, nearly 36 million people were 65 and older in the United States (U.S.), accounting for more than 12% of the total population (4). The U.S. older population grew rapidly for most of the 20th century, from 3.1 million in 1900 to 36 million in 2003 (4). By 2000, life expectancy reached a high of 76.9 years. According to U.S. Census Bureau projections, a substantial increase in the number of older people will occur during the 2010 to 2030 period, after the first Baby Boomers begin turning 65 in 2011 (4). By 2030, the older population is projected to be twice as large as in 2000, growing from 35 million to 72 million and representing nearly 20% of the total U.S. population at the latter date. As in most countries of the world, older women outnumber older men in U.S., with the excess being more pronounced at older ages (4).

Projections indicate that by 2030, the composition of the older population will be more diverse: 72% will be non-Hispanic White, 11% Hispanic, 10% Black, and 5% Asian. The older Hispanic population is projected to grow rapidly, from just over 2 million in 2003 to nearly 8 million in 2030. The older Hispanic population is projected to surpass the older Black population by 2030 (4).

People in the U.S. are living longer and healthier lives than ever before. However, about 80% of seniors have at least one chronic health condition and 50% have at least two. Arthritis, hypertension, heart disease, diabetes, and respiratory disorders are some of the leading causes of activity limitations among older people (4). Diabetes also affects the health of older people and limits their ability to perform activities. Among people 65 and older in 1999-2000, 15.1% of men and 13.0% of women reported having diabetes (4).

Death rates for Americans have decreased over the past century. In 2000, about three-quarters of the 2.4 million deaths in the United States (1.8 million) occurred to people aged 65 and older. Heart disease, malignant neoplasms (cancer), and cerebrovascular diseases (stroke) continue to be the leading causes of death among older Americans (4).

OVERVIEW OF THE KNOWLEDGE ON THE HEALTH OF MEXICAN AMERICAN ELDERLY

The population of Hispanics in the United States has increased dramatically and is already the largest minority group in the United States (5). The Hispanic population of the United States was estimated to be 37.4 million in 2002, representing 13.3% of the total population. Approximately two-thirds (66.9%) were of Mexican origin, 14.3% were Central and South American, 8.6% were Puerto Rican, 3.7% were Cuban, and the remaining 6.5% were of other Hispanic origin (6). The three major subgroups that make up the Hispanic population are Mexican Americans, Puerto Ricans, and Cubans (7). While only 5.5% of Mexican Americans are 65 or older, their number and proportions are expected to grow rapidly in the near future.

Hispanics are a diverse group of people of Spanish descent whose ancestors have lived in North America since the 1400s or who have immigrated more recently from Cuba, Puerto Rico, Mexico, and Central and South America (8, 9). Hispanics are more likely than non-Hispanic Whites to be under age 18, are more geographically concentrated, live in central cities of metropolitan areas, tend to have larger family households, are less likely to have graduated from high school, are more likely to be unemployed, to work in service occupations, to be operators or laborers, to have low incomes, and to live in poverty than the general population (6).

In the mid-1980s, the literature began identifying the existence of an "epidemiologic paradox" with respect to the health and mortality of the Mexican American population, whereby the socioeconomic profile of the population was similar to that of African Americans, but their health profile, especially with respect to mortality, was closer to that of the more advantaged non-Hispanic White population (3, 10, 11). This potential advantage was supported by data from the National Longitudinal Mortality Study (12) and by the linked data from the National Health Interview Survey-Multiple Cause of Death (13) which showed the advantage of lower overall mortality and mortality from cardiovascular disease and cancer despite high socioeconomic risk profiles.

Hispanic elderly suffer from a wide range of chronic diseases and disabilities (14-16). Diabetes has been recognized as a significant threat to the health and economic well being of the growing Hispanic population in the United States (17). Mexican Americans, the largest Hispanic subgroup, are over twice as likely to have diabetes as non-Hispanic Whites of similar age (18).

DIABETES

Diabetes mellitus is a disease characterized by high levels of blood glucose resulting from defects in insulin production, insulin action, or both (18). Insulin is a hormone that is needed to convert sugar, starches and other food into energy needed for daily life. The cause of diabetes continues to be a mystery, although both genetics and environmental factors such as obesity and lack of exercise appear to play roles (19). Diabetes is a chronic illness that requires continuing medical care and patient self-management to prevent acute complications and to reduce the risk of long-term complications (20).

In order to determine whether or not a patient has pre-diabetes or diabetes, health care providers conduct a Fasting Plasma Glucose Test (FPG) or an Oral Glucose Tolerance Test (OGTT). Either test can be used to diagnose pre-diabetes or diabetes. The American Diabetes Association (ADA) recommends the FPG because it is easier, faster, and less expensive to perform. The FPG test is a simple blood draw performed after an 8 hour fast. With the FPG test, a fasting blood glucose level between 100 and 125 mg/dl signals pre-diabetes. A person with a fasting blood glucose level of 126 mg/dl or higher has diabetes. In the OGTT test, a person's blood glucose level is measured after a fast and two hours after drinking a glucose-rich beverage. If the two-hour blood glucose level is between 140 and 199 mg/dl, the person tested has pre-diabetes. If the two-hour blood glucose level is at 200 mg/dl or higher, the person tested has diabetes (19).

TYPES OF DIABETES

Type 1 diabetes was previously called insulin-dependent diabetes mellitus (IDDM) or juvenile-onset diabetes. Type 1 diabetes develops when the body's immune system destroys pancreatic beta cells, the only cells in the body that make the hormone insulin that regulates blood glucose. This form of diabetes usually strikes children and young adults, although disease onset can occur at any age. Type 1 diabetes accounts for 5% to 10% of all diagnosed cases of diabetes. Risk factors for Type 1 diabetes may include autoimmune, genetic, and environment factors (18, 19).

Type 2 diabetes was previously called non-insulin-dependent diabetes mellitus (NIDDM) or adult-onset diabetes. Type 2 diabetes accounts for about 90% to 95% of all diagnosed cases of diabetes. It usually begins as insulin resistance, a disorder in which the cells do not use insulin properly. As the need for insulin rises, the pancreas gradually loses its ability to produce insulin. Type 2 diabetes is associated with older age, obesity, family history of diabetes, history of gestational diabetes, impaired glucose metabolism, physical inactivity, and race/ethnicity (18, 19).

Gestational diabetes is a form of glucose intolerance that is diagnosed in some women during pregnancy. During pregnancy, gestational diabetes requires treatment to normalize maternal blood glucose levels to avoid complications in the infant. After pregnancy, 5% to 10% of women with gestational diabetes are found to have Type 2 diabetes. Women who have had gestational diabetes have a 20% to 50% chance of developing diabetes in the next 5-10 years (18, 19).

Pre-diabetes is a condition that occurs when a person's blood glucose levels are higher than normal but not high enough for a diagnosis of Type 2 diabetes. Some 54 million Americans have pre-diabetes, in addition to the 20.8 million with diabetes (19).

Other specific types of diabetes result from specific genetic conditions (such as maturity-onset diabetes of youth), surgery, drugs, malnutrition, infection, or other illnesses. Such types of diabetes may account for 1% to 5% of all diagnosed cases of diabetes (18).

GENETIC PREDISPOSITION

Diabetes is a multifactorial disease in which environmental triggers interact with genetic variants in predisposition to the disease (21, 22). According to this multifactorial model, predisposition to the disease could be determined by many different combinations of genetic variants (genotypes) and environmental factors (diet, exercise, and lifestyle) (22). Many studies have been carried out to determine the genetic factors involved in Type 2 diabetes (22). Both diabetes Type 1 and 2 show a familial predisposition, which is a strong indication for the involvement of genes in people’s susceptibility to the disease (22). There is compelling evidence that genetic factors make a major contribution to the development of diabetes (23). Although the exact nature of genetic susceptibility is not yet understood, research findings support an HLA link (24). Also, a high genetic evidence was found in the high prevalence of diabetes in the Pima Indian population (25). Many patients with a genetic predisposition to diabetes also have a predisposition to weight gain, and obesity is a strong risk factor for diabetes (26). Also, it is particularly interesting to see that prevalence increases as ethnic groups migrate from lesser developed areas of the world to more urbanized or western regions (22).

Hispanics are known to be a population derived from three primary sources: American Indians, European whites, and Africans (27, 28). Because of a lack of a satisfactory genetic marker in Hispanics (29), the proportion of Native American genetic admixture provides an excellent proxy for genetic susceptibility to diabetes (30, 31). Assuming that Native Americans have an increased frequency of the diabetes gene, it is suggested that genetic susceptibility to diabetes is transmitted to Mestizo populations in proportion to their Native American ancestry (29, 32, 33).

ACCESS AND BARRIERS FOR DIABETES

Mexican Americans have been found to make less use of health care than non-Hispanic Whites and Blacks (34, 35). Previous research has identified various potential barriers which may impede Mexican Americans from obtaining medical care. These barriers include, but are not limited to, language and cultural differences, lack of transportation, geographic inaccessibility, financial constraints such as the cost of health care and limited health insurance coverage, and isolation from the mainstream culture (36-40).

This risk may stem, in part, from underutilization of screening services for the prevention and early detection of disease. Mexican Americans, for example, are less likely than non-Hispanic Whites to have routine medical check-ups, dental and eye examinations, prenatal care, and family planning (36, 41). It is possible that accessibility and availability of care (cost, geographic location, hours of operation, etc.) are more closely related to utilization of services while cultural and linguistic aspects relate more to satisfaction with care, compliance with treatment and continuance of treatment. (34).

Findings from the Hispanic Health and Nutrition Examination Survey (HHANES) conducted during 1982-4 reveal that Mexican Americans who are from low income groups, are of younger age, are less acculturated, lack health insurance coverage, have functional limitations, and have poorer perceived health status have reported more barriers to obtaining health care during their most recent medical encounter (34). The same study revealed that 35% of the Mexican American population was uninsured, followed by 29% of Cubans and 22% of mainland Puerto Ricans. It is uncertain whether increases in noncoverage among Hispanics are real and reflects changes over time, divergent sampling, and survey methods used, or whether the cultural and linguistic sensitivity of the HHANES resulted in findings of higher noncoverage among these population (35).

Findings from the San Antonio Heart Study (42) reported that poor health insurance coverage in the outpatient setting correlates with higher rates of microvascular complications in Mexican American with diabetes.

It is unfortunate that Mexican Americans with the highest need for health care tend to report the highest rates of encountering barriers which prevent them from obtaining needed care (34). Also, the lower socioeconomic status of some elderly Hispanics may cause difficulties in purchasing medications and paying for premiums associated with Medicare, Part B (43). However, older Hispanics may utilize informal health-care services such as curanderos in addition to their usual physician providers (43).

RISK FACTORS FOR DIABETES

Several factors are known to be associated with a risk for diabetes. Those factors can be nonmodifiable and modifiable factors. Nonmodifiable factors are old age, female gender, genetic predisposition, and socioeconomic status (SES). Modifiable factors are diet, obesity, lifestyle, and dyslipidemia.

Nonmodiafiable factors:

1) Old age. Several studies have shown that age is significantly associated with diabetes in Mexican American as well as in other populations (44-47). In the San Luis Valley Diabetes Study (48) and in the San Antonio Heart Study (47), the prevalence of diabetes in Mexican Americans was higher in the age groups 50-59 and 60-69 than in younger age groups.
2) Female gender. Several studies have shown that females have greater prevalence of diabetes than males (47-49). Also, different rates for women versus men have been found for diagnosed and undiagnosed diabetes separately (49). The San Luis Valley Diabetes Study (48) reported that Hispanic females had higher prevalence of confirmed diabetes than Anglo females.
3) Genetic predisposition. Genetic predisposition in Mexican Americans has been described above. The development of diabetes is also predicted by elevated insulin concentrations in Mexican Americans (44).
4) Socioeconomic status. A number of socio-cultural factors have been associated with both the prevalence and incidence of diabetes in Mexican Americans (7). Lower education (50, 51), low annual income (52, 53), low acculturation (54), low physical activity, and diets rich in fat and carbohydrate intake appear to play a role in the severity of diabetes (7).

Among Mexican Americans in the San Luis Valley Diabetes Study, higher prevalence of diagnosed diabetes was associated with fewer years of education and lower annual income (44, 55). In the San Antonio Heart Study, higher levels of acculturation and education were significantly associated with a lower prevalence of diabetes (54). However, in the HHANES, there was no significant association between diabetes prevalence and acculturation among Mexican Americans (56).

Modifiable factors:

1) Diet. The relation between diet and diabetes in Mexican Americans was examined in the San Luis Valley Diabetes Study. Subjects with newly diagnosed diabetes and impaired glucose tolerance had higher fat consumption and lower carbohydrate consumption than subjects with normal glucose tolerance (57). Also, dietary fiber intake was higher among persons with known diabetes than among nondiabetic subjects (58).
2) Obesity. Obesity is the most common and costly nutritional problem in the United States, affecting approximately 33 percent of adults (59). The prevalence of obesity has increased over the past 15 years (60). More than 50% of US adults are overweight, with a body mass index of more than 25 Kg/m^2 (61). The prevalence of obesity is higher in Mexican Americans than in non-Hispanic Whites (62). Overweight and obesity are recognized as major underlying risk factors for diabetes and coronary heart disease (CHD) (44, 55, 63, 64). However, excess obesity in Mexican Americans only partially accounts for their higher prevalence of diabetes compared with non-Hispanic Whites (7).

   Not only overall obesity, but also the distribution of obesity is associated with diabetes. There has been a recent resurgence of interest in the role of body fat distribution in the development of various chronic diseases, among them diabetes

(65). Both upper body obesity, as measured by the ratio of waist-to-hip circumference, and central adiposity, as measured by the ratio of subscapular to triceps skinfolds, are positively associated with the prevalence of diabetes in the San Antonio Heart Study (66), the San Luis Valley Diabetes Study (55), and the Starr County, Texas study (67, 68).

3) Lifestyle. The relation between physical activity and diabetes has been examined in several Hispanic populations. Lifestyle factors such as decreased physical activity, changes in diet including increased caloric intake, and rapid modernization into Western society are strong contributors to increased diabetes prevalence in this population (69).

   Recent studies demonstrate that enhanced physical activity may delay or prevent the transition from impaired glucose tolerance to Type 2 diabetes mellitus (70). Regular physical activity raises HDL cholesterol, lowers LDL level, leads to lower blood pressure, reduces insulin resistance, and favorably influences cardiovascular function (63). In the HHANES survey, the prevalence of diabetes in Mexican Americans declined with increasing occupational physical activity after controlling for age and obesity (56).

4) Dyslipidemia. Lipid abnormalities include hypertriglyceridemia, decreased high density lipoprotein (HDL, the good cholesterol) and increased low density lipoprotein (LDL) (71). Accumulated excess visceral obesity is believed to be the site for production of dyslipidemia associated with insulin resistance (72).

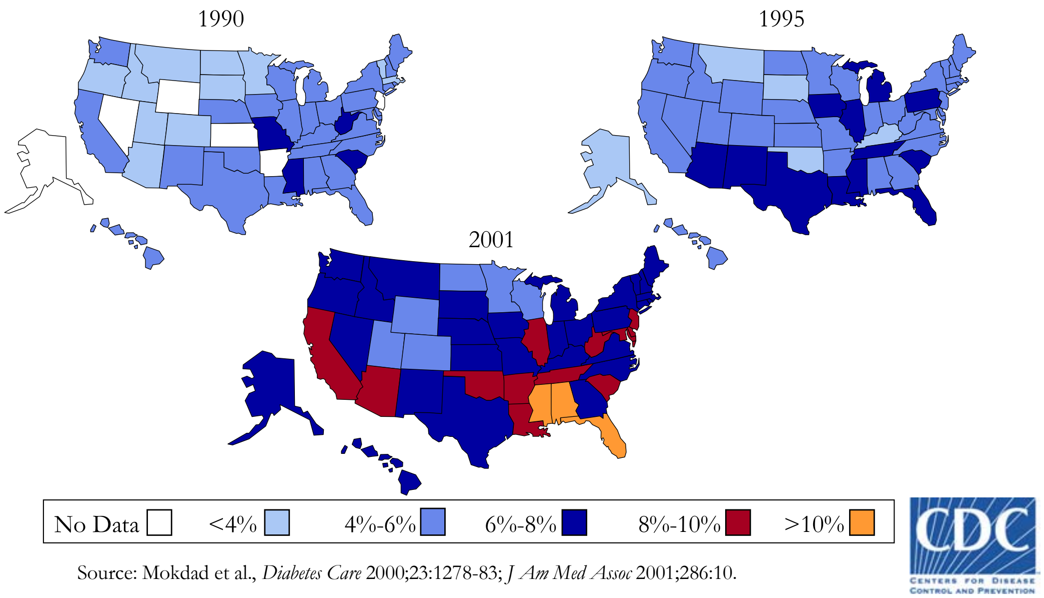
   Dyslipidemia is commonly found in patients with Type 2 diabetes (73). Data reported from NHANES III have shown that Mexican Americans men and women have higher prevalence of hypertriglyceridemia and low HDL cholesterol levels than non-Hispanic Whites or African Americans (74).

EPIDEMIOLOGY OF DIABETES

The prevalence of diabetes is increasing, and World Health Organization estimates suggest that by 2025 there will be 300 million affected individuals worldwide. The number of people with diabetes is increasing due to population growth, aging, urbanization, and increasing prevalence of obesity and physical inactivity (75, 76). The prevalence of diabetes for all-age groups worldwide has been estimated at 2.8% in 2000 and 4.4% in 2030 (76). The urban population in developing countries is projected to double between 2000 and 2030. The most important demographic change affecting diabetes prevalence across the world appears to be the increase in the proportion of people >65 years of age (76).

An estimated 20.8 million people in the United States--7.0 percent of the population--have diabetes, a serious, lifelong condition. Of those, 14.6 million have been diagnosed, and about 6.2 million remain undiagnosed. Of the 20.8 million, 10.9 million are men and 9.7 million are women (77). Each year, about 1.5 million people aged 20 or older are diagnosed with diabetes. The prevalence of total diabetes rises with age, reaching 21.6% for those age >65 years (45). It is estimated that by the year 2030 there will be 30.3 million people with diabetes in the United States (78). The economic cost of diabetes in medical expenditures and lost productivity was estimated to be $132 billion in the U.S. in 2002 (79).

FIGURE 1. DIABETES TRENDS AMONG ADULTS IN THE UNITED STATES BRFSS, 1990, 1995 AND 2001 (80)



Prevalence of diagnosed diabetes varies considerably by race (49, 81). Rates for the three major racial/ethnic groups in the U.S. are based on the National Health Interview Survey, the NHANES, and the HHANES (45, 82, 83). Rates among blacks and Mexican Americans in the U.S. are more than twice the rates among whites (45, 84). The prevalence of diagnosed diabetes increased in all age-groups, sex groups, and racial/ethnic groups, but the increase was most prominent in those of older age (45, 84).

In addition to the high rates of diagnosed diabetes, there appears to be a considerable number of people who meet oral glucose tolerance test (OGTT) criteria for diabetes but have not yet been diagnosed (84). The prevalence of undiagnosed diabetes ascertained by measuring Fasting Plasma Glucose (FPG) in the NHANES 1999-2002 was 2.8% in the total population aged >20 years (45).

Hispanic elderly suffer from a wide range of chronic diseases and disabilities. Diabetes has been recognized as a significant threat to the health of the growing Hispanic population in the United States. Diabetes is more common in Mexican Americans (11, 46, 48, 85-87). About 2.5 million (9.5% of all Hispanics) aged 20 years or older have diabetes (18, 80). Several studies confirm that diabetes is more common in Mexican American females (48, 81, 88, 89) than in males. The prevalence of diabetes is higher among older Hispanics (22.4%) than among older non-Hispanic Whites (12.5%) (4).

The high prevalence of diabetes in Mexican Americans has been established by four large studies: the San Antonio Heart Study (87), the San Luis Valley Diabetes Study (48, 90), the Starr County Study (46), and the HHANES, which covered all five southwestern states (7). Table 1 below summarizes the parameters of these studies.

TABLE 1. SUMMARY OF SELECTED DIABETES PREVALENCE IN MEXICAN AMERICANS

Characteristics	San Antonio	San Luis	Starr County	HHANES
Sample	2,217 Phase 1 2,619 Phase 2	997	2,498	15,105
Age range	25-64	20-74	15-74	20-74
Ethnicity	Mexican Am. / Whites	Hispanic / Whites	Mexican Americans	Mexican Am Puerto Rican Cubans
Prevalence	10.1%	7.3%	6.8%	Mex Am: 23.9% P.Rican: 26.1% Cuban: 15.8%
Place	Texas	Colorado	Texas	AZ, CA, CO, NM, TX, NY, and FL
Year	1979-82 1984-88	1983-88	1981-83	1982-84

The San Antonio Heart Study was carried out in two phases, during 1979-82 and during 1984-88. Diabetes was diagnosed by a 2-hour OGTT in those aged 25-64 years. Subjects were sampled from three types of neighborhoods: low-income barrios, middle-income transitional neighborhoods, and high-income suburbs. Age-adjusted prevalence for men was 14% in the barrio versus 6.5% in the suburbs, and for women was 18% in the barrio versus 4.3% in the suburbs. The increased prevalence of diabetes in Mexican Americans in this study was the result of an increased incidence rather than enhanced survival because, among prevalent diabetic subjects at baseline, mortality was higher among Mexican Americans than among non-Hispanic Whites (44).

The San Luis Valley Diabetes Study was a geographically based case-control study in Alamosa and Conejos counties, in the San Luis Valley of Southern Colorado (48). In this study, all persons with previously diagnosed diabetes residing in the two counties, as well as a random sample of individuals with no previous history of diabetes, were invited to receive a medical examination. Diabetes was diagnosed or verified by OGTT and the age group examined was 20-74 years. Hispanic males had a 2.1 fold excess of confirmed diabetes compared with Anglo males, whereas Hispanic females were 4.8 times more likely than Anglo females to have diabetes (48).

In the Starr County study (46), prevalence of hyperglycemias was assesses in Mexican Americans residing in Starr County, Texas in 1981. The study included 2,498 persons aged >15 years. A total of 5.2% of males and 5.3% of females aged >15 years had a history of previously diagnosed diabetes and were either taking antidiabetic medications or fulfilled the National Diabetes Data Group (NDDG) criteria for diabetes. The age and sex specific prevalence of diabetes for subjects 65-74 years old was 16.7% for males and 17.0 % for females respectively.

The HHANES is the only study to include information on Mexican Americans, Puerto Ricans, and Cubans (91). HHANES measured diabetes prevalence in Mexican Americans of the southwestern United States, Puerto Rican Americans of New York, and Cubans Americans in Dade County, Florida (92). The HHANES is the largest and most comprehensive Hispanic health survey ever carried out in the United States between 1982 – 1984 with a sample size of 15,105 Hispanics (93). The sample was representative of approximately 76% of the 1980 Hispanic-origin population of the United States. This study collected a wide spectrum of socioeconomic, health and demographic data; administered physical and dental examination; and took diagnostic specimens and conducted specialized tests, producing one of the most complete and unique Hispanic health data bases available to date (93). The diabetes component of the survey consisted of a diabetes history interview, and an OGTT. Among subjects aged 45-74, prevalence of diabetes was 23.9% in Mexican Americans and 26.1% in Puerto Rican Americans, but only 15.8% in Cuban Americans (92). Also, the rate of diabetes was higher among elderly Mexican American than among either elderly Cubans or elderly Puerto Ricans (97).

Two studies have provided data on the incidence of diabetes in Hispanics. In the San Antonio Heart Study (44, 95-97), the incidence of NIDDM in Mexican Americans varied by neighborhood. The 8-year incidence of NIDDM was 8.7% among Mexican Americans in low-income barrio neighborhoods, 8.4% among Mexican Americans in transitional neighborhoods, and 3.4% in suburban neighborhoods. When compared with diabetes incidence among non-Hispanic Whites, this represents a 1.6 times higher odds of having diabetes among Mexican Americans in transitional neighborhoods and a 2.2 times higher odds of having diabetes among Mexican Americans in suburban neighborhoods.

In the San Luis Valley Study (85), the 6-year incidence of previously diagnosed diabetes was estimated for Hispanics and non-Hispanic Whites. When adjusted for age, the incidence of reported diabetes was 2.5 times higher in Hispanic men than in non-Hispanic White men, and the incidence in Hispanic women was 3.8 times higher than in non-Hispanic White women. For both sexes, excess diabetes risk in Hispanics was greater in the young and declined with advancing age (85).

In both studies, Hispanics had higher incidence of diabetes than non-Hispanic Whites. This suggests a pattern of early onset of diabetes among Hispanics compared to non-Hispanic Whites (65, 85). The reasons for early onset of diabetes are not clear, but may include an interplay of environmental and genetic factors (85). The early age of onset of diabetes has major public health significance: it means diabetes is more likely to afflict Mexican Americans in the prime of life (65). Earlier onset will also lengthen the duration of diabetes at any given age. Since microvascular complications of diabetes (retinopathy, nephropathy, and neuropathy) are strongly duration-dependent, excess complications might be expected in Hispanics (85).

The incidence of complications associated with diabetes is also substantial, resulting from delays in diagnosis, poor treatment compliance, communication problems between health care providers and patients, and a general lack of knowledge about the disease, its complications, and available treatments (43, 98).

OVERVIEW OF COMPLICATIONS

Apart from short term complications such as thirst, malaise, tiredness, and ketoacidosis, diabetes mellitus often leads to a number of long term complications, generally subdivided into micro- and macrovascular complications (19). Microvascular complications include retinopathy, neuropathy, and nephropathy, with Type 2 diabetes a main cause of blindness, lower limb amputations, and renal failure in adults.

Macrovascular complications mean that diabetes is a major risk factor for cardiovascular diseases and stroke.

The explanation for microvascular complications in Mexican Americans is likely to be multifactorial. First, Mexican Americans with diabetes are more hyperglycemic than non-Hispanic Whites with diabetes. Second, Mexican Americans have an early onset of diabetes, which may lead to a relatively longer duration especially if age-specific mortality is similar. Third, Mexican Americans may have a genetic predisposition to microvascular complications, independent of the inheritance of the diabetes itself (42, 99, 100).

Hispanics in the United States have higher rates of diabetes and diabetes complications than non-Hispanic Whites (101). Much of the diabetes in Mexican Americans is thought to be undiagnosed, because of cultural and economic barriers to medical care (14, 43, 102). Recent studies show Mexican Americans to be in "double jeopardy" in that they not only have a greater chance of developing diabetes, but also a greater risk of suffering from its many complications (43, 103-105) and subsequent functional impairments (106, 107). The greater frequency of complications and severity of diabetes in Mexican Americans (7, 14) can lead not only to increased risk for overall disease severity, but also increased diabetes-related mortality (7, 52, 108, 109).

Much of our knowledge regarding the rates of diabetic complications come from four studies of Mexican Americans: the San Antonio Heart Study (7, 65, 95, 99, 100), the San Luis Valley Diabetes Study in southern Colorado (48, 85, 110), the Starr County Study in south Texas (46, 108) and the NHANES III (56).

Mexican Americans in the San Antonio Heart Study were found to have higher blood sugars, higher rates of microvascular complications of diabetes (diabetic eye and renal disease), and higher systolic and diastolic blood pressure compared to non-Hispanic

Whites. They were approximately twice as likely to have severe retinopathy (99), more likely to have proteinuria and microalbuminemia (100), and had a six fold higher incidence of diabetic end-stage renal disease (111), but had lower prevalence of myocardial infarction than non-Hispanic Whites (62, 95). Also, Mexican Americans were found to have a higher prevalence of peripheral vascular disease than non-Hispanic Whites, as assessed by ankle/arm blood pressure ratios (65).

In the San Luis Valley Diabetes study subjects were between 20 – 74 years of age (48). Levels of hyperglycemia and microvascular complications were similar in Mexican American and non-Hispanic white diabetic subjects (110). However, the prevalence of diabetic retinopathy was lower in Hispanics than in non-Hispanic Whites (48). Diabetic nephropathy and neuropathy indicated either no difference or an excess in non-Hispanic Whites relative to Hispanics (48). No data were available on coronary heart disease from the Colorado study (110).

In the Starr County Study, a high incidence of retinopathy and premature mortality from cardiovascular disease among diabetic Mexican Americans was found over an 8-year follow-up (108). Also, subjects were considered to have "severe" hyperglycemia if they were currently taking antidiabetic medications (46).

The Third National Health and Nutrition Examination Survey (NHANES III) showed an excess of microvascular complications in diabetic Mexican Americans compared with non-Hispanic Whites (56). In addition, the prevalence of diabetic retinopathy was higher in Mexican Americans than in non-Hispanic Whites (112). Table 2 summarizes these diabetes complications among Mexican Americans in these studies.

TABLE 2. SUMMARY OF SELECTED DIABETES COMPLICATIONS STUDIES IN MEXICAN AMERICANS

Complications	San Antonio	San Luis	Starr County	NHANES III
Retinopathy	3.18(1.32-7.66)	0.40(0.21-0.76)	38%	33.4(26.7-40.1)
ESRD∗	2.82(1.05-7.55)	1.11(0.54-2.27)	N/A	N/A
Heart attack	0.73(0.31-1.71)	N/A	N/A	N/A
PVD†	1.84(0.75-4.49)	N/A	N/A	29.7%
Neuropathy	N/A	26.3(20.2-32.4)	N/A	N/A
Amputations	N/A	N/A	N/A	N/A
Mortality	12.9%	N/A	25.5%	N/A

∗ESRD: End-stage renal disease
†PVD: Peripheral vascular disease

CONSEQUENCES

Heart attack

Heart disease is the leading cause of death in the United States among all major ethnic populations including Mexican Americans (113-115). Adults with diabetes have heart disease death rates about 2 to 4 times higher than adults without diabetes (18). The risk of heart attack increases with age in persons with or without diabetes (113, 116) but diabetes appears to accelerate the process (115).

Mexican Americans are more likely to have diabetes, obesity (114), high levels of cholesterol and triglycerides (62), lower levels of HDL cholesterol (62), high blood pressure (114), lower socioeconomic status, less education (87), and greater hospitalization rates, including both incident and recurrent events of heart attack (116).

An analysis from the NHANES III (1988-1994) found that Mexican American older women had higher prevalence of cardiovascular risk factors, after accounting for age and socioeconomic status (114). Other studies in Mexican Americans demonstrate a greater incidence of heart attack (86, 116), but a decreased prevalence of self-reported heart attack compared with non-Hispanic Whites (95) and low cardiovascular mortality (117, 118). The lower rate of coronary heart disease in diabetic Mexican Americans raises the possibility that their increased prevalence of microvascular complications could be the result of differential survival relative to non-Hispanic White diabetics (65).

In the San Antonio Heart Study, Mexican American men, whether diabetic or not, had a lower prevalence of myocardial infarction (62). Similar results were reported from the San Luis Valley Diabetes Study where Hispanics tended to have a lower prevalence of myocardial infarction than non-Hispanic Whites (119). It may seem paradoxical that Mexican Americans have lower cardiovascular disease mortality than non-Hispanic Whites in view of their excess rates of obesity and diabetes (14).

Stroke

Stroke is the fourth major cause of death and disability among all Hispanics Americans and is the third leading cause in Hispanics aged 65 and older (120, 121). People who have diabetes and diabetes complications are at a greater risk to have a stroke (122-124). The risk for stroke is 2 to 4 times higher among people with diabetes (18). In addition, stroke victims may have undetected diabetes when stroke occurs (84, 122, 123). Age, race, hypertension, and the presence of diabetes nephropathy and coronary and peripheral vascular disease are risk factors for stroke in patients with diabetes (122, 123, 125).

Little is known about the influence of diabetes on stroke's disabling consequences for elderly Hispanics, even though diabetes and stroke are both associated with deficits in activities of daily living (ADLs) and health-related quality of life (101, 106, 120, 124, 126).

Mortality

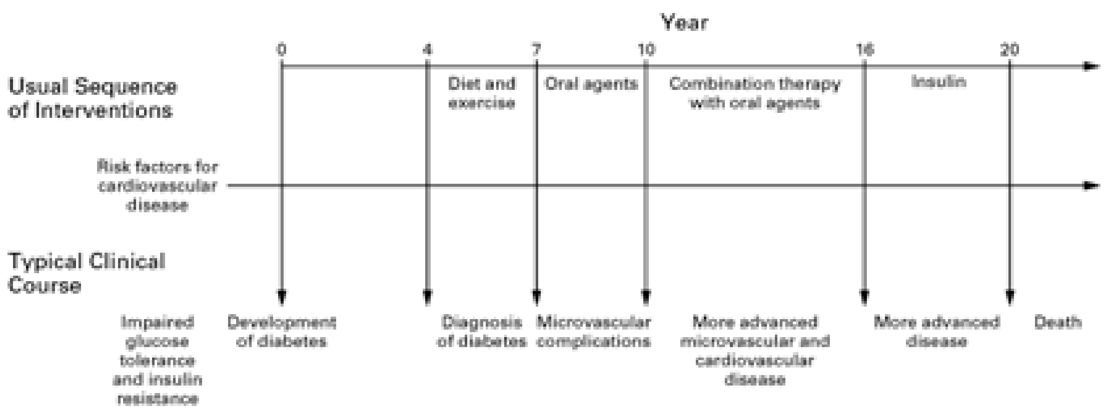
Diabetes was the sixth leading cause of death listed on U.S. death certificates in 2000. Diabetes is likely to be underreported as a cause of death. Studies have found that only about 35% to 40% of decedents with diabetes have diabetes listed anywhere on the death certificate and only about 10% to 15% have it listed as the underlying cause of death. Overall, the risk for death among people with diabetes is about 2 times that of people without diabetes (18).

Mexican Americans with diabetes experience premature and excessive mortality compared with other populations with diabetes (12, 108, 127). Elderly Mexican American men have a greater risk of dying from diabetes and renal failure than their non-Hispanic White counterparts (86). Numerous studies have documented the morbidity associated with diabetes, but mortality data have been relatively limited in the Hispanic population (108). Most mortality data on Hispanic Americans pertain specifically to Mexican Americans and, to a lesser extent, Puerto Ricans (7).

According to a retrospective death certificate review from Bexar County, Texas, Mexican American elders had a three-fold mortality risk attributable to diabetes compared to non-Hispanic Whites (86). However, there are few longitudinal studies examining diabetic complications in relation to long-term mortality in Hispanic Americans (108). In cohort data from the San Antonio Heart Study (86) mortality among diabetic persons was higher in both ethnic groups than among non-diabetics. Additional cohort data have been reported from Starr County, Texas (108) where among known diabetics, diabetes was mentioned only on 25.5% of death certificates.

In another death certificates review filed in the United States in 1978, in which diabetes was selected as the underlying cause of death, cardiovascular and renal conditions were extremely prominent contributing causes to death (84). The excess in death for diabetes, relative to that of people without the disease, was often twofold or greater, and this excess persisted among elderly versus middle-aged patients (84).

FIGURE 2. THE TYPICAL CLINICAL COURSE OF TYPE 2 DIABETES, INCLUDING PROGRESSION OF GLYCEMIA, DEVELOPMENT OF COMPLICATIONS, AND THE USUAL SEQUENCE OF INTERVENTIONS (128)



TREATMENT AND FUTURE TREATMENT DIRECTIONS

People with diabetes should receive medical care from a physician-coordinated team. Such a team may include, but not be limited to, physicians, nurse practitioners, physician assistants, nurses, dietitians, pharmacists, and mental health professionals with expertise and interest in diabetes (129). A complete medical evaluation should be performed to classify the patient, detect the presence or absence of diabetes complications, assist in formulating a management plan, and provide a basis for continuing care (129).

The care of older adults with diabetes is complicated by their clinical and functional heterogeneity. Older persons with diabetes have higher rates of premature death, functional disability, and coexisting illnesses such as hypertension, coronary heart disease, and stroke than those without diabetes. Older adults with diabetes are also at greater risk than other older persons for such common geriatric syndromes as polypharmacy, depression, cognitive impairment, urinary incontinence, injurious falls, and persistent pain (129).

Although there are few data on compliance with therapeutic regimens in diabetic Mexican Americans (130), it is possible that worse compliance accounts for their less-satisfactory metabolic control (14). In addition, data from the Hispanic EPESE suggests that an inconsistent use of diabetic medication was associated with an increased risk of kidney problems and death over a 7-year period in older Mexican Americans (131).

There is good evidence from middle-aged and older adults suggesting that multidisciplinary interventions that provide education on medication use, monitoring, and recognizing hypo- and hyperglycemia can significantly improve glycemic control (129). Although control of hyperglycemia is important in older persons with diabetes, greater reductions in morbidity and mortality may result from control of all cardiovascular risk factors rather than from tight glycemic control alone (129).

Glycemic control is fundamental to the management of diabetes. Prospective randomized clinical trials such as the Diabetes Control and Complications Trial (DCCT) (132) and the U.K. Prospective Diabetes Study (UKPDS) (133) have shown that improved glycemic control is associated with sustained decreased rates of retinopathy, nephropathy, and neuropathy (134). In these trials, treatment regimens that reduced average HbA1c to ~7% were associated with fewer long-term microvascular complications (129). In addition, lipid management, blood pressure control, eye care and foot care can prevent or retard progression of diabetes complications (135-137).

Approximately one fourth of elderly diabetics are treated with insulin and one half with oral hypoglycemic therapy (84). Long term intensified insulin treatment, as compared with standard treatment, retards the development of microvascular complications in patients with insulin-dependent diabetes (132).

Older patients can be treated with the same drug regimens as younger patients, but special care is required in prescribing and monitoring. Metformin is often contraindicated because of renal insufficiency or heart failure. Sulfonylureas and other insulin secretagogues can cause hypoglycemia. Insulin can also cause hypoglycemia and requires good visual and motor skills and cognitive ability of the patient or caregiver. Thiazolidinediones should not be used in patients with congestive heart failure (129).

Cure for diabetes will require permanent replacement of lost β-cell function, which could involve islet cell transplantation, regeneration of β cells, or development of an immortalized insulin secreting cell line (1). A major multidisciplinary effort is required to identify the genes that predispose to diabetes and to identify the interacting environmental factors that trigger the disease (1). Advances in methods of gene therapy could make genetic interventions a reality for this disorder (1).

The availability of new pharmaceutical treatment, together with the ability to predict diabetes susceptibility, will provide a sound basis for early intervention and will lead to the prevention of diabetes in susceptible individuals (1). If an appropriate health care delivery system can disseminate these new therapeutic modalities to all diabetic patients, then control or prevention of diabetes will be a reality. In this event, the burden of diabetes complications will gradually diminish and ultimately disappear (1).

PREVENTION

Research studies have found that lifestyle changes can prevent or delay the onset of Type 2 diabetes among high-risk adults. Lifestyle interventions include diet and moderate-intensity physical activity (18).

Studies have also shown that medications have been successful in preventing diabetes in some populations groups. In the Diabetes Prevention Program, people treated with the drug Metformin reduced their risk of developing diabetes by 31% over 3 years. Treatment with Metformin was most effective among younger and heavier people, and less effective among older and less overweight people. In addition to preventing progression from IGT to diabetes, lifestyle changes and medication have also been shown to increase the probability of reverting from IGT to normal glucose tolerance (18).

Research studies in the U.S. and abroad have found that improved glycemic control benefits people with diabetes. In general, for every 1% reduction in results of HbA_1c blood test, the risk of developing microvascular diabetic complications (eye, kidney, and nerve disease) is reduced by 40% (18). Also, culturally competent diabetes self-management education was effective in improving health outcomes and reducing HbA_1c levels in a Mexican American population (137).

Lifestyle modification such as weight management and increased physical activity reduces the risk of diabetes among persons with Impaired Fasting Glucose (IFG) (139). Regular exercise may prevent Type 2 diabetes in high risk individuals (70), improve blood glucose control, improve insulin sensitivity in skeletal muscle, reduce cardiovascular risk factors, contribute to weight loss, and improve general well-being (129).

Diabetes complications can be managed by controlling levels of blood glucose, blood pressure, and blood lipids and by receiving other preventive care practices in a timely manner (18). Preventive measures will be focused on the detection and prevention of visual impairment, foot problems, kidney problems, and acute hyperglycemia and ketoacidosis (140).

Furthermore, the Centers for Disease Control and Prevention (CDC) plans to increase the number of diabetes prevention and control programs, expand research and surveillance activities to address the unique needs of women and children with diabetes, develop and carry out a national public health strategy to address type 2 diabetes among children, and expand the activities of the National Diabetes Education Program (18).

SUMMARY

Diabetes mellitus is one of the most common chronic diseases affecting Mexican American elders in the United States. Findings reported in this dissertation indicate that older Mexican Americans with diabetes have a high risk of developing complications and consequently are more likely to have a heart attack and stroke which lead to early mortality compared to Mexican American elders without diabetes. These findings are important because of the uniqueness of the sample and the availability of eleven-year follow-up data.

CHAPTER 3: METHODS

This project will examine prevalence and correlates of diabetes and diabetes complications (retinopathy, nephropathy, peripheral vascular disease, and amputations), the association between diabetes and 7-year incidence of heart attack, stroke, and mortality, and factors associated with glycemic control as measured by HbA_1c levels in diabetic Mexican Americans elders. Together, these data provide valuable information to examine prevalence and incidence of diabetes, diabetes complications, and other risk factors in Mexican American elders.

AIMS:

AIM 1: To examine the prevalence and correlates of diabetes among Mexican American elders.

HYPOTHESIS 1.A. Female elders have higher prevalence of diabetes compared to male elders with diabetes.

HYPOTHESIS 1.B. Poor socioeconomic status will be associated with diabetes.

AIM 2: To examine the prevalence and correlates of diabetes complications (retinopathy, nephropathy, peripheral vascular disease, and amputations) among Mexican American elders.

HYPOTHESIS 2.A. Age will be associated with more diabetes complications.

HYPOTHESIS 2.B. Length of the disease will be associated with more diabetes complications.

AIM 3: To examine the association between diabetes and 7-year incidence of cardiovascular disease (heart attack and stroke) among Mexican Americans elders.

HYPOTHESIS 3.A. Mexican American elders with diabetes experience high incidence of heart attack compared to Mexican American elders without diabetes.

HYPOTHESIS 3.B. Mexican American elders with diabetes experience high incidence of stroke compared to Mexican American elders without diabetes.

AIM 4: To examine the association between diabetes and 7-year mortality among Mexican American elders.

HYPOTHESIS 4.A. Number of diabetes complications will be associated with an increased risk of mortality.

AIM 5: To examine the factors associated with glycemic control (HbA_1c measure).

HYPOTHESIS 5.A. Poor glycemic control will be associated with severity of the disease.

DATA AND SAMPLE COLLECTION

Data come from the Hispanic Established Population for the Epidemiological Study of the Elderly (EPESE). In 1992, the National Institute of Aging funded the Hispanic EPESE to provide epidemiologic data on one of the fastest growing elderly populations in the United States. Baseline data were collected on 3,050 Mexican Americans age 65 years and older using multi-stage probability sampling in five southwestern states of Arizona, California, Colorado, New Mexico, and Texas during 1993-1994. The sample design was modeled after the earlier EPESE studies from New Haven, East Boston, North Carolina, and rural Iowa. To develop the sampling frame, all counties from the five states were ranked according to the number of older Mexican Americans until 90% of the population was included. From this universe of counties, census tracts were ranked until 90% of the older Mexican American population was included, which constituted the 300 primary sampling units (PSU). In the second stage, a list of all the blocks within the census tracts (PSUs) was created on which systematic random selection of blocks was performed. Interviewers then screened a total of 175 households within each selected block and interviewed eligible adults within each household. Eligible respondents were identified based on reported age, self-identification as a Mexican American, reported birthplace (Mexico or the U.S.), and a review of the ethnic background of an individual's parents or grandparents. Interviews were conducted in Spanish or English with all members of the household who were Mexican Americans aged 65 and over. The response rate was 83 percent at baseline (1993-1994), which was comparable to the other EPESE studies.

Bilingual interviewers (Spanish and English) who conducted all interviews were trained by the project staff and by employees of Harris Interactive Inc. formerly Louis Harris & Associates was responsible for the fieldwork. Interviews were conducted in the home of the respondent or their proxy. The baseline and second interview lasted approximately 90 minutes, with the third, fourth, and fifth interviews each lasting approximately 60 minutes. Each interviewer at each of the five interviews gathered information on socio-demographic, health conditions, and psychosocial characteristics of the subjects or their proxy. In addition, anthropometric measures, blood pressure measures, and physical function measures of upper and lower body of the subjects were obtained.

Baseline household interviews were conducted in 1993-1994. Subsequently across eleven years, four other waves of data have been collected in 1995-1996, 1998-1999, 2000-2001, and 2004-2005. At wave 5, a sample of 902 Mexican Americans aged 75 years old were added. An HbA_1c test to measure glycemic control for diabetics was incorporated in the study. The Hispanic EPESE is currently in the early stage of collecting wave 6 data on 2,069 subjects: 902 from the new cohort and 1,167 from the original cohort aged 75 and over during 2004-2005.

TABLE 3. SUMMARY OF THE HISPANIC EPESE SAMPLE: BASELINE, 2ND WAVE, 3RD WAVE, 4TH WAVE, AND 5TH WAVES

Interview period	Total	Proxy	Deceased	Refused	Not Located	Age
1993-4	3050	177	--	--		65+
1995-6	2438	143	238	110	264	67+
1998-9	1980	145	423	124	285	70+
2000-1	1682	101	282	137	288	72+
2004-5	1167	92	467	145	328	75+
Added sample						
2004-5	902	49	--	--	--	75+

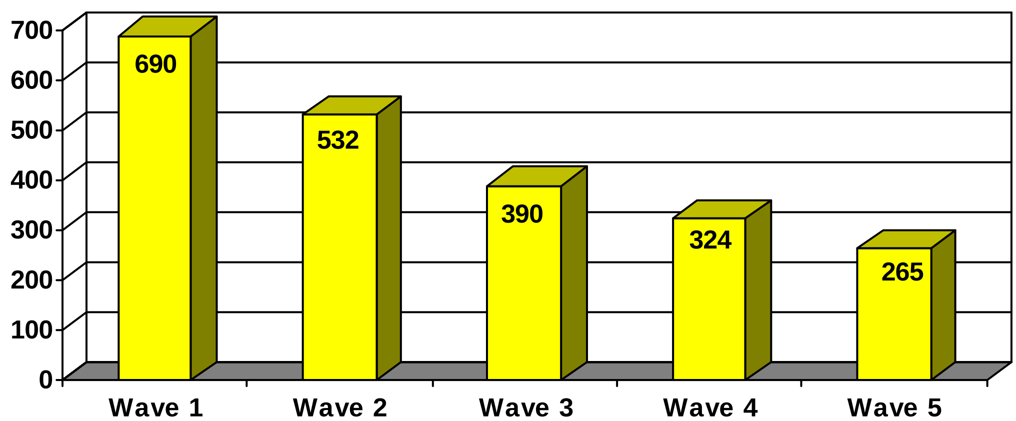
The Hispanic EPESE provides a large probability sample of older Mexican Americans with data collected on functional, mental, physical, and social domains of health. Additionally, these data were collected prospectively over eleven years of follow-up. Older Mexican Americans were sampled using census tracts as PSUs, which facilitates the merging of US Census tract data with the Hispanic EPESE and fulfills the required statistical sampling assumptions for multilevel analysis.

STUDY POPULATION

Data employed are from the baseline interview and 2nd, 3rd, 4th, and 5th interview of the Hispanic EPESE. The sample is representative of approximately 500,000 older Mexican Americans. The 3,050 subjects completed in-home face to face interviews in either Spanish or English, depending on the respondent's preference. All interviewers were fully bilingual. At the baseline interview (93-94), 690 subjects reported having received a physician's diagnosis of diabetes. At the second interview (95-96) there were

532 diabetic subjects. In the third interview (98-99) there were 390 such subjects. At the fourth interview (00-01) there were 324 diabetic subjects. And at the fifth interview (04-06) there were 265 diabetic subjects.

FIGURE 3 DISTRIBUTION OF SUBJECTS WITH DIABETES FROM THE HISPANIC EPESE BY WAVE



MEASUREMENTS

Independent variables measured at baseline, 2nd, 3rd, 4th, and 5th follow-up

Sociodemographic factors

A) Age as a continuous measure and categorical variable (65-74, 75-84, 85+)

B) Gender (Male and female)

C) Marital status (married, separated, divorced, widowed, and never married) (Married=1 and Unmarried=0)

D) Years of formal education

E) Place of birth (United States or Mexico)

F) Language of interview (English or Spanish)

G) Health Insurance (covered or not covered)

H) Household Income

I) Living arrangements (Live alone or living with others)

Health behaviors

A) Alcohol status was assessed by asking subjects whether they were a non drinker, current drinker, or former drinker.

B) Smoking status was assessed by asking subjects whether they were a never smoker, current smoker, or former smoker.

C) Body Mass Index (BMI) was be computed by dividing weight in kilograms by height in meters squared. Anthropometric measurements were collected in the home using the methods and instructions employed in other EPESE studies. Four BMI categories were created: <22 Kg/m^2, 22 kg/m^2 to <26 Kg/m^2, 26 to <30 Kg/m^2, and >30 Kg/m^2. Persons with BMIs of 30 or over were considered obese (141).

D) Self-rated Health Status (excellent, good, fair, and poor).

Pathology

A) Diabetes: A prior physician diagnosis of diabetes was assessed with the question: Have you ever been told by a doctor that you have diabetes, sugar in your urine or high blood sugar?

B) Diabetes complications were assessed by asking the following questions:

- Retinopathy: As a result of your diabetes, have you ever had any problem with your eyes, or not?
- Nephropathy: As a result of your diabetes, have you ever had any problem with your kidneys, or not?
- Peripheral vascular disease: As a result of your diabetes, have you ever had

any problems with the circulation in your legs or arms, or not?

- Amputations: Have you ever had any part of your body amputated as a result of your diabetes, or not?

  Fingers

  Toes

  One foot

  Both feet

  Lower leg

  Both lower legs

  Other (specify)

C) Family history (categorized as none/unknown, one parent and both parents)

D) Length of the disease (categorized as up to 5 years, 6 to 14 years, 15 to 20 years, and over 20 years from diagnosis)

E) Received treatment (categorized as none, oral hypoglycemic, insulin, and the combination of both oral hypoglycemic and insulin)

Functional disability

A) Activities of daily living (ADL) include walking across a small room, bathing, grooming, dressing, eating, transferring from a bed to a chair, and toileting. The ADL disability level was measured from a modified version of the Katz ADL scale (142). Subjects were asked if they could perform the ADL activity without help, if they needed help, or if they were unable to do the activity. For the analysis, ADL disability will be dichotomized as no help needed versus needed help with or unable to perform one or more of the seven ADL activities.

B) Instrumental activities of daily living (IADL) include the ability to use a telephone, drive, shop, prepare meals, perform light housework, take medications, handle money, perform heavy housework, walk up and down stairs, and walk half a mile. These were assessed using the modified Rosow-Breslau scale of mobility function (143). Subjects were asked to indicate if they could perform the IADL activity alone or needed help to do the activity. For the analysis, IADL disability will be dichotomized as no help needed versus needed help to perform one or more of the ten IADL activities.

Comorbid conditions

Medical conditions were assessed by asking respondents if they have received a physician diagnosis of:

- Heart attack: "Has a doctor told you had a heart attack, or coronary, or myocardial infarction, or coronary thrombosis?"
- Stroke: "Did a doctor ever tell you that you had a stroke, a blood clot in the brain, or brain hemorrhage?"
- Hypertension: "Has a doctor ever told you that you have high blood pressure?"
- Cancer: "Has a doctor ever told you that you had a cancer, or a malignant tumor of any type?"
- Hip fracture: "Since the age of 50 have you ever been told by a doctor that you had a broken or fractured hip?"
- Arthritis: "Have you ever been told by a doctor that you have arthritis or rheumatism?"

Health Service Utilization

A) Hospitalization was assessed by asking respondents the number of hospitalizations in the year prior to each interview.

- "How many different times were you hospitalized?"

B) Doctor visit was assessed by asking respondents the number of doctor's visits in the year prior to each interview.

- "How many times in the past 12 months, that is since (Date one year ago) have you visited with a medical doctor?"

Psychological status

Depression was measured with the Center for Epidemiologic Studies Depression Scale (CES-D) (144), the most widely used survey measure of depressive symptomatology in studies of older adults. This scale has been found reliable and valid in the elderly (145), and is predictive of both current and future clinical depression (146). For the present study, a dichotomous measure was derived based on a score of 16 or greater on the CES-D, indicative of high levels of depressive symptomatology (147).

Dependent variables measured at 2nd, 3rd, 4th, and 5th follow-up interview

HEART ATTACK: "Has a doctor ever told you that you had a heart attack, or coronary, or myocardial infarction, or coronary thrombosis?"

STROKE "Did a doctor ever tell you that you had a stroke, a blood clot in the brain, or brain hemorrhage?"

MORTALITY: Vital status of Hispanic EPESE subjects was ascertained by two methods: 1) field information from interviews with proxy-respondents and 2) a mortality search performed by either the Epidemiology Resources, Inc. (ERI) or by the National Death

Index (NDI). Based on Social Security and other biographic information, ERI used the Social Security Administration Death Master Files to determine the vital status of subjects whose status was unknown. Through the 2004/2005 (fifth) wave of data collection, a total of 1,167 subjects were alive and were interviewed while 1,410 subjects were deceased. The remaining 473 subjects either refused to participate or were lost at follow-up.

HBA_1C MEASURE was assessed by a dried blood spot kit. Respondents who replied "yes" to having diabetes at the time of the 5th interview were given the option to receive the HbA_1c kit to perform a finger prick test. Then, after performing the test, respondents were instructed to place the kit in an envelope and mail it to FlexSite Diagnostics in Palm City, Florida for processing. For analysis purposes, HbA_1c will be categorized as $\leq$7.9% (good control) and $\geq$8% (poor control).

ANALYTIC SUBSAMPLES

AIM 1: The main focus of this aim is to examine the prevalence and correlates of diabetes among Mexican American elders (n=3050). For this aim, the baseline interview will be used to determine the prevalence, rates on demographic, socioeconomic status, and health-related characteristics of diabetic Mexican American elders.

HYPOTHESIS 1.A. Diabetes will be more prevalent among females than males.

- Chi-square statistics will be used to examine the statistical significance of prevalence rates between male and female diabetic Mexican American elders.

HYPOTHESIS 1.B. Poor socioeconomic status will be associated with diabetes.

- Chi-square statistics will be used to examine the statistical significance of prevalence between socioeconomic status (measured by education and household income) in diabetic Mexican American elders.

AIM 2: The major focus of this aim is to examine the prevalence and correlates of diabetes complications (retinopathy, nephropathy, peripheral vascular disease, and amputations) among Mexican American elders with diabetes (n=690). For this aim, the baseline interview will be used to examine the prevalence rates of diabetes complications (retinopathy, nephropathy, peripheral vascular disease, and amputations) and correlates.

HYPOTHESIS 2.A. Age will be associated with more diabetes complications.

- Age will be categorized in two groups: 65 to 74 years and 75 years or older.
- Diabetes complications will be classified as having no complications and having one or more complications.
- Chi-square analysis will be used to examine the statistical significance of prevalence between age and diabetes complications.

HYPOTHESIS 2.B. Length of the disease will be associated with more diabetes complications.

- Length of the disease will be categorized as up to 10 years and 11 or more years from diagnosis.
- Diabetes complications will be classified as having no complications and one or more complications.
- Chi-square analysis will be used to examine the statistical significance of prevalence between length of the disease and diabetes complications.

AIM 3: The main focus of this aim is to examine the association between diabetes and 7-year incidence of cardiovascular disease (heart attack and stroke) among Mexican Americans elders (n=3050). For this aim, baseline interview and all subjects who remained in the sample through the 2^{nd}, 3^{rd}, and 4^{th} follow-up interviews will be used.

HYPOTHESIS 3.A. Mexican American elders with diabetes experience a high incidence of heart attacks compared to Mexican American elders without diabetes.

- We will determine the prevalence rates for heart attack in diabetic Mexican American elders at baseline.
- Logistic regression analysis will be used to assess the risk (odds ratio (OR)) of having a heart attack at baseline and having new heart attack at 2nd, 3rd, and 4th follow-up in diabetic Mexican American elders.
- Cox Proportional Hazard Ratio analysis will be used to estimate the risk of mortality over the 7-year follow-up for people reporting heart attack with and without the presence of diabetes.

HYPOTHESIS 3.B. Mexican American elders with diabetes experience high incidence of stroke compared to Mexican American elders without diabetes.

- We will determine the prevalence rates for stroke in diabetic Mexican American elders at baseline.
- Logistic regression analysis will be used to estimate the OR of having stroke at baseline and new stroke at 2nd, 3rd, and 4th follow-up in Mexican American elders.
- Cox Proportional Hazard Ratio analysis will be used to estimate the risk of mortality over the 7-year follow-up for people reporting stroke with and without the presence of diabetes.

AIM 4: The main focus of this aim is to examine the association between diabetes and 7-year mortality among Mexican American elders (n=690). For this aim, all subjects who were reported dead and those who remain in the sample through the 2nd, 3rd, and 4th follow-up interviews will be used.

HYPOTHESIS 4.A. Number of diabetes complications will be associated with an increased risk of mortality.

- Diabetes complications will be classified as having no complications and one or more complications.

• Death information will be determined from family members and a mortality search performed by Epidemiology Resources Inc.

• Cox Proportional Hazard Ratio analysis will be used to estimate the risk of mortality over the 7-year follow-up on people who had one, two, three, and four diabetic complications compared to those diabetic subjects without complications.

AIM 5: The main focus of this aim is to examine the factors associated with glycemic control (HbA_1c measure). For this aim, we used all diabetic subjects from baseline, 2nd, 3rd, 4th, and 5th follow-up interviews plus diabetic subjects from the added sample who were performed an HbA_1c test (n=209).

HYPOTHESIS 5.A. Poor glycemic control will be associated with severity of the disease.

• Insulin users will be employed as a measure of (??) severity of the disease.

• Severity of the disease will be categorized as insulin user with and without.

• HbA_1c test reports from the 5th wave will be categorized as $\leq$7.9 (good control) and $\geq$8% (poor control).

• Logistic regression analysis will be used to estimate the OR of the insulin users in the good and poor glycemic control groups.

All analysis will be performed using SAS statistical package, version 9.1.3 (SAS Institute, Inc. Cary, NC) (148, 149).

SAMPLE SIZE AND STATISTICAL POWER

There are 690 diabetics in the sample (22% from a total sample of 3,050). The strategy for the power analysis will be to demonstrate how much power is available for each Aim, given this fixed sample size. Estimates of effect and other assumptions will be described as necessary. Power calculations will show the ability to test hypotheses using a two-sided alpha level of significance of 0.05, and a total n=690. Calculations were performed using the POWER procedure in SAS (149).

Assumptions used for all calculations:

1. Alpha level of significance (two-sided) of 0.05

2. Fixed sample size: n=690 diabetics; N=3,050 total sample size

AIM 1: For Aim 1, we investigate gender differences and socioeconomic status in Mexican American elders with diabetes.

Hypothesis 1.a: Gender differences

• Estimates of prevalence of diabetes available from Otiniaro et al. (103) indicate male diabetics have a prevalence of 45% and females a prevalence of 55%. The table below shows the available power for an additional scenario. The table indicates that a difference of proportions of approximately 0.12 will be sufficient for 87% power.

Aim 1.a. Power for a chi-square test, N=690

	Prevalence Estimates			
Scenario	Males	Females	Difference	% Power
1	.45	.55*	.10	73
2	.44	.56	.12	87

* From Otiniano et al.

Hypothesis 1.b: Socioeconomic status (Education and household income)

• ***EDUCATION:*** Estimates of prevalence of diabetes available from Otiniaro et al. (103) indicate low education in diabetics have a prevalence of 89% and high education in diabetics was 11%. The difference of proportions is approximately 0.78 and there is sufficient power for this hypothesis.

Aim 1.b. Power for a chi-square test, N=690

	Prevalence Estimates			
Scenario	Low education	high education	Difference	% Power
1	.89	.11*	.78	>.99

* From Otiniano et al.

• ***HOUSEHOLD INCOME:*** Estimates of prevalence of diabetes available from Otiniaro et al. (103) indicate a 56% prevalence of low household income for diabetics and a 44% prevalence of high household income for diabetics. The difference of proportions of approximately 0.12 will be sufficient for 84% power.

Aim 1.b. Power for a chi-square test, N=690

	Prevalence Estimates			
Scenario	<10,000 income	>10,000 income	Difference	% Power
1	.56	.44*	.12	84

* From Otiniano et al

AIM 2: For Aim 2, we investigate diabetes complications and how they are related to age and length of the disease.

Hypothesis 2.a: Age

• Estimates of prevalence of diabetes complications available from Otiniano et al. (103, 104) indicate that age group 65-75 have a prevalence of 58% and the age group >75 have one of 63%. The difference of proportions is approximately 0.05 and there is not sufficient power for this hypothesis.

Aim 2.a. Power for a chi-square test, N=690

	Prevalence Estimates of Diabetes complications			
Scenario	Age 65-74	Age >75	Difference	% Power

1	.58	.63*	.05	22

* From Otiniano et al.

Hypothesis 2.b: Length of the disease

• Estimates of prevalence of diabetes complications available from Otiniano et al. (103, 104) indicate that length of disease up to 10 years have a prevalence of 52% and length of disease for 11 or more years is 69%. The difference of proportions of approximately 0.17 will be sufficient for 99% power.

Aim 2.b. Power for a chi-square test, N=690

	Prevalence Estimates of Diabetes complications			
Scenario	Up to 10 years	11 years or more	Difference	% Power
1	.52	.69*	.17	99

* From Otiniano et al.

AIM 3: For Aim 3, we investigate the association of cardiovascular disease (heart attack and stroke) in Mexican American elders with diabetes.

Hypothesis 3.a: Heart attack

• Estimates of the incidence of heart attack available from Otiniano et al. (105) indicate that heart attack in diabetics is 15% and heart attack in non diabetics is 7%. The difference of proportions of approximately 0.08 will be sufficient for 99% power.

Aim 3.a. Power for a chi-square test, N=3050

	Incidence Estimates of Heart attack			
Scenario	Diabetics	Non diabetics	Difference	% Power
1	.15	.07*	.08	99

* From Otiniano et al.

Hypothesis 3.b: Stroke

• Estimates of the incidence of stroke available from Otiniano et al. (107) indicate that stroke in diabetics is 11% and stroke in non diabetics is 5%. The difference of proportions of approximately 0.06 will be sufficient for >99% power.

Aim 3.b. Power for a chi-square test, N=3050

	Incidence Estimates of Stroke			
Scenario	Stroke + DM	Stroke + Non DM	Difference	% Power
1	.11	.05*	.06	>99

* From Otiniano et al.

AIM 4: For Aim 4, we investigate the association of diabetes complications related to mortality in Mexican American elders with diabetes

Hypothesis 4: Mortality

• Estimates of the incidence of mortality available from Otiniano et al. (109) indicate that mortality in diabetics with complications was 45% and mortality in diabetics without complications was 32%. The difference of proportions of approximately 0.13 will be sufficient for >90% power.

Aim 4. Power for a chi-square test, N=690

	Incidence Estimates of Mortality			
Scenario	With complications	Without complications	Difference	% Power
1	.45	.32*	.13	>90

* From Otiniano et al.

AIM 5: For Aim 5, we investigate the association of poor glycemic control and severity of the disease (measured by insulin users).

Hypothesis 5: Glycemic control

• Estimates of the 5th wave prevalence of insulin user is 30% in diabetics with poor glycemic control (HbA1c>8%) and 14% in diabetics with good glycemic control (HbA1c<7.9%). The difference of proportions is approximately 0.16 and provide a power of 78%.

Aim 5. Power for a chi-square test, N=209

	Prevalence Estimates of Insulin users			
Scenario	HbA1c >8%	HbA1c<7.9%	Difference	% Power
1	.30	.14	.16	78

LOST TO FOLLOW-UP

Table 4 shows the description of subjects by status at the end of follow-up (11 years). Subjects with confirmed death at the end of follow-up through the National Death Index (NDI) were older, significantly more likely to report diabetes, have diabetes complications, have more severe disease (more disease duration and more insulin use), report more heart attack events, stroke, hypertension, and have more ADL limitations compared with those who where reinterviewed in person, reinterviewed by proxies, lost to follow-up or who refused to be reinterviewed.

Subjects who were reinterviewed by proxy had the lowest education grade and the lowest BMI compared to subjects who were reinterviewed in person, deceased, lost to follow-up or who refused to be reinterviewed at the end of the follow-up.

Knowledge of these characteristics in an older Hispanic population will be useful in promoting education and developing lifestyle changes beginning in early adulthood to manage the disease and to prevent future complications in this high risk population.

TABLE 4. DESCRIPTIVE CHARACTERISTICS OF ORIGINAL SUBJECTS AT BASELINE BY STATUS AT THE END OF FOLLOW-UP (2005)

Explanatory variable	Re interviewed N=1074	Re interviewed by proxy N=93	Deceased N=1,410	Refused to be reinterviewed/ Lost of follow-up N=473
Age, mean ± SD	71.1±4.8	75.6±6.4	76.3±7.4	70.6±4.9
Gender (Female) n, %	672 (63%)	65 (70%)	729 (52%)	292 (62%)
Education mean ± SD	5.0±3.8	3.7±3.5	4.6±3.9	5.3±4.0
BMI*, mean ± SD	28.5±4.9	26.4±4.7	27.1±5.4	28.3±5.6
Diabetes n, %	185 (17%)	16 (17%)	416 (30%)	73 (15%)
Diabetes complications† n, %	90 (22%)	10 (2%)	272 (66%)	40 (10%)
Diabetes length >15 years n,%	60 (26%)	6 (3%)	146 (63%)	18 (8%)
Insulin use n, %	40 (22%)	1 (.5%)	123 (66%)	21 (11%)
Heart attack n, %	76 (27%)	3 (1%)	172 (62%)	27 (10%)
Stroke n, %	33 (17%)	6 (3%)	132 (69%)	19 (10%)
Hypertension n,%	417 (33%)	30 (2%)	632 (51%)	171 (14%)
Any ADL‡ limitation n, %	44 (10%)	13 (3%)	333 (79%)	31 (7%)

* BMI: Body mass index
† Diabetes complications included retinopathy, nephropathy, peripheral vascular disease, and amputations
‡ ADL: Activities of daily living

CHAPTER 4: PREVALENCE AND INCIDENCE OF DIABETES AND ITS COMPLICATIONS

PREVALENCE OF SELF-REPORTED DIABETES

This chapter reports results of the cross sectional analysis at baseline of self-reported physician-diagnosed diabetes and self-reported physician-diagnosed diabetes complications and other factors in Mexican American elders with diabetes. These findings have been reported in Otiniano et al. (103, 104).

The Mantel-Haenszel Chi-Square statistic was used to test associations in demographic variables, socioeconomic, and medical characteristics between subjects with and without diabetes complications at baseline.

In order to produce results that were representative of older Mexican Americans in the five southwestern states, all analyses incorporated weighted data and were conducted using the SUDAAN program (150). Confidence intervals were obtained using the SAS system for Windows, version 9.1.3 (SAS Institute, Cary, NC).

In multivariate logistic regression model, we have adjusted for socio-demographic factors and other chronic conditions measured in the study. Because we employed an area probability sample with primary sampling units of 300 census tracts, we adjust for design effects to remove any clustering bias in our estimates. This was accomplished by using a Taylor Linearization method from the SUDAAN program (150). Weights were applied to represent appropriate proportions of older Mexican Americans in each of the five southwestern states. Weights were obtained by taking into account several factors during the sampling process: distribution and differential probability of selection of Mexican Americans aged 65 or older \ was applied at the level of the census tracts; and ratios for each state and gender were computed by dividing the sample size of 3050 by the census population size of 498,176.

Table 5 presents the prevalence of self-diagnosed diabetes and the prevalence of self-diagnosed diabetes complications in Mexican American elders. Of the 690 subjects, 278 (40%) did not have any complications, 412 (60%) had one or more complications. Thirty-eight had retinopathy, 14% reported having nephropathy 40% had peripheral vascular disease, and 8% had amputations.

TABLE 5. PREVALENCE OF DIABETES AND DIABETES COMPLICATIONS IN MEXICAN AMERICAN ELDERS AT BASELINE

Diabetes	690 (22%)
• Without complications	278 (40%)
• With complications*	412 (60%)
Retinopathy	269 (38%)
Nephropathy	99 (14%)
Peripheral vascular disease	280 (40%)
Amputations	62 (8%)

* Mexican American elders with complications may have more than one complication

At baseline, a total of 690 subjects reported having diabetes (Table 6). Of the 690 diabetics, 412 (60%) had one or more complications. Seventy-four percent were aged 65 to 74, 22% were aged 75 to 84, and only 4% were over 85 years of age or older. Approximately 45% were males and 55% were females; 59% were born in United States, whereas 41% were born in Mexico. Bivariate analyses indicated no substantial differences in rates of diabetes complications across age, gender, or place of birth.

Table 6 also presents factors such as marital status, education level, language of interview, presence of health insurance coverage, and household income. Fifty-eight percent of the subjects were married. Fifty-one percent had less than five years of education, 37% had five to eleven years and only 12% had 12 or more years of education.

Seventy-one percent completed the interview in Spanish and 29% in English. About 6% of Mexican-American diabetics had no insurance coverage. Fifty-six percent have an income of less than 10,000 dollars and 44% have an income of 10,000 dollars or over. Educational differences were evident: respondents with 12 or more years of education were less likely to have diabetes complications than those with less than 12 years of education (p=0.05). No differences were seen in rates of complications by language of interview, presence of health insurance coverage or household income.

TABLE 6. SOCIO-DEMOGRAPHIC CHARACTERISTICS OF MEXICAN AMERICANS ELDERS WITH DIABETES MELLITUS THAT ADJUSTED FOR THE FINAL SAMPLING WEIGHTS

Socio- Demographic	Total	With Complications	Without Complications	P
Overall:	690 (100%)	412 (60%)†	278 (40%)	
Age Group:				
- 65-74	494 (74)*	288 (55)	206 (45)	0.50
- 75-84	166 (22)	106 (58)	60 (42)	
- ≥ 85	30 (4)	18 (68)	12 (32)	
Gender:				
- Male:	291 (45)	171 (54)	120 (46)	0.40
- Female:	399 (55)	241 (58)	158 (42)	
Place of Birth:				
- Mexico:	276 (41)	173 (58)	103 (42)	0.73
- USA:	414 (59)	239 (56)	175 (44)	
Marital Status:				
- Married:	401 (58)	238 (57)	163 (43)	≤0.01
- Non married	289 (42)	174 (57)	115 (43)	
Levels of Education:				
- < 5	376 (51)	233 (58)	143 (42)	0.05
- 5-11	236 (37)	144 (61)	92 (39)	
- ≥12	73 (12)	33 (39)	40 (61)	
Language of Interview:				
- Spanish:	536 (71)	313 (55)	223 (45)	0.47
- English:	154 (29)	99 (60)	55 (40)	
Health Insurance Coverage:				
- Covered:	656 (94)	385 (55)	271 (45)	0.11
- Not covered:	34 (6)	27 (74)	7 (26)	

Household Income‡:				
- ≤10,000	320 (56)	205 (63)	115 (37)	0.08
- ≥10,000	293 (44)	162 (54)	131 (26)	

∗column percent
† row percent
‡ denominator did not include 77 cases with missing value

Source: Otiniano et al. Ethnicity & Disease 2002;12:252-8

Table 7 shows the description of medical factors, including family history, length of the disease, treatment received, and related comorbid conditions such as stroke, heart attack and hypertension. Those with none/unknown family history comprised 75% of the sample, 20% reported one diabetic parent and 5% reported two diabetic parents. Despite the large number in the none/unknown category (which may reflect lack of knowledge or information about the disease state of their parents), family history was more common among those who had complications (p=0.06). Respondents having the disease for five or fewer years comprised 27% of the sample, 36% had the disease 6 to 14 years, 18% for 15 to 20 years, and 19% for more than 20 years. Diabetes complications were more common among those having diabetes for 15 or more years (p=0.001). Five percent reported receiving no treatment, 58% received only oral hypoglycemics, 31% received insulin only, and 6% received both oral hypoglycemics and insulin. Type of treatment was not statistically associated with complications.

Of the 690 subjects, approximately 12% reported ever having a stroke, 15% reported a heart attack, and 56% reported hypertension. Bivariate analyses indicated that respondents who had a stroke (p=0.01), a heart attack (p=0.009), or hypertension (p=0.06) were all more likely to report complications.

TABLE 7. HEALTH-RELATED CHARACTERISTICS OF MEXICAN AMERICANS ELDERS WITH DIABETES MELLITUS THAT ADJUSTED FOR THE FINAL SAMPLING WEIGHTS

	Total n=690 (%)	With Complications n=412 (%)	Without Complications n=278 (%)	P
Family History:				
- None/Unknown:	531 (75)*	301 (54)†	230 (46)	0.06
- One parent:	130 (20)	89 (58)	41 (42)	
- Both parents:	29 (5)	22 (82)	7 (18)	
Length of the disease:				
- Up to 5 years:	161 (27)	79 (43)	82 (57)	0.001
- 6 to 14 years:	244 (36)	142 (59)	102 (41)	
- 15 to 20 years:	104 (18)	73 (67)	31 (33)	
- ≥ 20 years:	124 (19)	89 (72)	35 (28)	
Received Treatment:				
- None:	28 (5)	9 (24)	19 (76)	0.10
- Pills:	440 (58)	254 (57)	186 (43)	
- Insulin:	185 (31)	126 (63)	59 (37)	
- Pills + Insulin:	32 (6)	22 (57)	10 (43)	
Related comorbid complications:				
- Stroke:	76 (12)	57 (74)	19 (26)	0.01
- Heart Attack:	105 (15)	78 (69)	27 (31)	0.009
- Hypertension	394 (56)	253 (61)	141 (39)	0.06

∗ column percent

† row percent

Source: Otiniano et al. Ethnicity & Disease 2002;12:252-8.

PREVALENCE OF SELF-REPORT OF DIABETES COMPLICATIONS

Of the 690 subjects, 278 (40%) did not have any complications and 412 (60%) had one or more complications. Thirty-eight had retinopathy, 14% reported having nephropathy 40% had peripheral vascular disease, and 8% had amputations.

Table 8 shows the results of the logistic regression analysis of any complications on the socio-demographic and health-related factors. Variables adjusted for outcomes were age group, gender (male), education (≥12 years), marital status (married), language of interview (Spanish), insurance coverage (covered), length of the disease (15 to 20 years and ≥20 years), treatment received (insulin + hypoglycemics and insulin only), heart attack, and stroke. Having any complications was strongly associated with low education, years since diagnosis of diabetes and heart attack, after controlling for other factors. Respondents with 12 or more years of education were less likely to have complications (OR 0.32, 95% CI=0.15-0.68). However, having diabetes for 20 or more years (OR 1.97, 95% CI=1.12-3.47) and having heart attack (OR 2.36, 95% CI=1.26-4.40) were associated with increased complications.

The logistic regression analyses modeling individual complications found that being in the age group of 75-84 (OR 0.29 95% CI=0.09-0.97) and being male (OR 0.45, 95% CI=0.25-0.84) were associated with lower risk for nephropathy, whereas having a heart attack (OR 2.92, 95% CI=1.55-5.52) was associated with elevated risk for nephropathy. The risk for retinopathy was lower among those with a high school education (OR 0.36, 95% CI=0.17-0.76), but higher among those with the disease for 15 or more years (OR 2.16, 95% CI=1.09-4.26) or 20 or more years (OR 2.05, 95% CI=1.21-3.49) and among those reporting a heart attack (OR 1.96, 95% CI=1.10-3.51). Peripheral vascular disease was lower in those with 12 or more years of education (OR 0.40, 95% CI=0.18-0.90), and higher among those with diabetes for 20 or more years

(OR 2.25, 95% CI=1.33-3.81), those receiving insulin or the combination of hypoglycemics and insulin (OR 1.61, 95% CI=1.03-2.51), and those reporting a heart attack (OR 2.32, 95% CI=1.31-4.12). The risk for amputations was also elevated among those having diabetes for 15 or more years (OR 2.70, 95% CI=1.27-5.75).

Table 9 shows the prevalence of lower extremity amputations among Mexican American elders with diabetes and selected risk factors at baseline. There are statistically significant differences between subjects with and without amputations for the following variables: obesity (p=0.02), retinopathy (p=<0.01), peripheral vascular disease (p<0.01), arthritis (p=0.03), any ADL limitation (p=<0.01) and IADL limitation (p=<0.01). Being hospitalized and having doctor visits in the past year did not differ across the two groups. Amputations were more common among those having diabetes for 10 or more years (p=<0.01). Five percent of amputees reported receiving no treatment, and 95% received oral hypoglycemics, insulin, or both.

TABLE 8. RESULTS OF LOGISTIC REGRESSION MODELS PREDICTING ANY AND SELECTED COMPLICATIONS IN MEXICAN AMERICAN ELDERS WITH DIABETES (N=685)

Complications:	Any OR 95%CI	Kidney OR 95%CI	Eyes OR 95%CI	Circulation OR 95%CI	Amputations OR 95%CI
Age Group*					
- 65-74	0.63 (0.22-1.82)	0.36 (0.12-1.04)	1.60 (0.54-4.77)	0.63 (0.20-1.96)	0.29 (0.07-1.22)
- 75-84	0.59 (0.18-1.93)	0.29 (0.09-0.97)	1.84 (0.55-6.20)	0.61 (0.18-2.03)	0.35 (0.07-1.89)
Gender (Male)	0.78 (0.52-1.15)	0.45 (0.25-0.84)	1.08 (0.78-1.50)	0.67 (0.45-1.01)	1.31 (0.62-2.75)
12 years edu.†	0.32 (0.15-0.68)	0.72 (0.28-1.86)	0.36 (0.17-0.76)	0.40 (0.18-0.90)	0.75 (0.27-2.06)
Length of the disease‡					
15 to 20 yrs	1.50 (0.68-3.29)	1.03 (0.44-2.41)	2.16 (1.09-4.26)	1.48 (0.79-2.77)	2.70 (1.27-5.75)
$\geq$ 20 years	1.97 (1.12-3.47)	1.24 (0.60-2.57)	2.05 (1.21-3.49)	2.25 (1.33-3.81)	0.69 (0.25-1.92)
Insulin +					
Pills/Insulin§	1.28 (0.77-2.13)	1.23 (0.70-2.16)	1.17 (0.69-1.99)	1.61 (1.03-2.51)	1.79 (0.89-3.60)
Heart Attack	2.36 (1.26-4.40)	2.92 (1.55-5.52)	1.96 (1.10-3.51)	2.32 (1.31-4.12)	1.38 (0.56-3.37)

* reference group = > 85 years old; † reference group = < 12 years of education; ‡ reference group= < 15 years; § reference group = no treatment.
Besides the present variables show in this table, outcomes were adjusted with marital status, language of interview, insurance coverage and stroke.

Source: Otiniano et al. Ethnicity & Disease 2002;12:252-8.

TABLE 9. PREVALENCE OF LOWER EXTREMITY AMPUTATIONS AMONG MEXICAN AMERICAN ELDERS WITH DIABETES AND SELECTED RISK FACTORS AT BASELINE

Risk Factors	Non-Amputated n=630 (%)	Amputated n=60 (%)	p
Smoker	250 (40)	34 (46)	0.49
Obesity (BMI≥30+)*	236 (45)	24 (66)	0.02
Eye problems	235 (34)	34 (61)	<0.01
Kidney problems	86 (12)	13 (28)	0.08
Circulation problems	220 (32)	60 (100)	<0.01
Stroke	65 (11)	11 (22)	0.16
Hypertension	360 (56)	34 (58)	0.85
Heart Attack	93 (15)	12 (20)	0.47
Hip Fracture	17 (3)	6 (15)	0.08
Arthritis	319 (50)	19 (32)	0.03
Hospitalization†	465 (72)	36 (63)	0.27
Doctor visits‡	578 (95)	56 (98)	0.09
Any ADL	110 (18)	31 (55)	<0.01
Any IADL	385 (63)	54 (90)	<0.01
Length of the disease			
- < 10 years	330 (54)	19 (22)	<0.01
- ≥10 years	300 (46)	41 (78)	
Received Treatment			
- None	28 (5)	4 (5)	0.77
- Pills or/and Insulin	602 (95)	56 (95)	

* Denominator did not include 89 cases with missing values on obesity.
† Hospitalized in the past 12 months.
‡Visited physician in the past 12 months.

Source: Otiniano et al. Journal of Diabetes and Its Complications 2003;17:59-65.

Table 10 describes the type of lower extremity amputations at baseline and two subsequent follow-ups. Leg amputation was the most common type of amputation at baseline, first and second follow-ups, followed by foot amputation. Toe amputation was the least common type.

TABLE 10. DESCRIPTION OF TYPES OF LOWER EXTREMITY AMPUTATIONS IN MEXICAN AMERICAN ELDERS WITH DIABETES AT BASELINE AND TWO SUBSEQUENT FOLLOW-UPS

	Baseline 1993-1994 n (%)	1st Follow-up 1995-1996 n (%)	2nd Follow-up 1998-1999 n (%)
- Toes	11 (18)	9 (20)	4 (12)
- Foot	15 (25)	15 (33)	12 (38)
- Leg	32 (53)	19 (42)	15 (47)
- Other	2 (4)	2 (5)	1 (3)
Total:	60 (100)	45 (100)	32 (100)

Source: Otiniano et al. Journal of Diabetes and Its Complications 2003;17:59-65.

INCIDENCE OF DIABETES COMPLICATIONS OVER 11-YEAR PERIOD

This section reports results of incidence of diabetes and diabetes complications over 11-year follow-up of Mexican American elders.

The analysis reported in Table 11 was done by Chi-square statistics. Previous self-reported complications were excluded from analysis at each follow-up.

Table 11 shows the incidence of diabetes and diabetes complications at each interview, from 1993-4 to 2004-5. At the baseline interview (93-94), 690 (22%) subjects reported having received a physician's diagnosis of diabetes. At the 1st follow-up (95-96) there were 532 (23%) diabetic subjects. At the 2nd follow-up (98-99) there were 390 (21%) subjects. At the 3rd follow-up (00-01) there were 324 (21%) subjects. And at the fourth follow-up, there were 265 (23%) subjects with diabetes.

Thirty-eight percent of subjects with complications reported having retinopathy at baseline. At the 1st, 2nd, 3rd, and 4th follow-ups there were 15%, 11%, 5%, and 8% respectively.

Fourteen percent of subjects reported having nephropathy at baseline. At the 1st, 2nd, 3rd, and 4th follow-ups there were 6%, 8%, 6%, and 6% respectively.

Forty percent of subject reported having peripheral vascular disease at baseline. At the 1st, 2nd, 3rd, and 4th follow-up, there were 14%, 13%, 5%, and 8% respectively.

Only 8% of subjects reported having amputations at baseline. At the 1st, 2nd, and 3rd follow-ups there were 8%, 11%, and 9% respectively. However, at the 4th follow-up no subjects reported having amputations.

TABLE 11. BASELINE PREVALENCE AND FOLLOW-UP INCIDENCE OF DIABETES AND DIABETES COMPLICATIONS ACROSS 11-YEAR STUDY

Interview	Cases recruited at baseline	Cases of Diabetes	Retinopathy n (%)	Nephropathy n (%)	PVC* n (%)	Amputations n (%)
Baseline (93-94)	3050	690 (22%)	269 (38%)	99 (14%)	280 (40%)	62 (8%)
1st Follow-up (95-96)	2261	532 (23%)	82 (15%)	31 (6%)	76 (14%)	44 (8%)
2nd Follow-up (98-99)	1849	390 (21%)	42 (11%)	31 (8%)	50 (13%)	45 (11%)
3rd Follow-up (00-01)	1518	324 (21%)	15 (5%)	20 (6%)	15 (5%)	31 (9%)
4th Follow-up (04-05)	1167	265 (23%)	22 (8%)	18 (6%)	23 (8%)	- -

* PVC denotes peripheral vascular disease.

TABLE 12. PERCENT OF SUBJECTS WITH NEW, 2ND AMPUTATION, AND MORTALITY AT THE TWO FOLLOW-UPS AND CUMMULATIVE MORTALITY AT 5-YEAR FOLLOW-UP AMONG DIABETIC AMPUTEES MEXICAN AMERICAN ELDERS

1st Follow-up (1993-4 to 1995-6)

Diabetic elders	New amputations	2nd amputations	Deaths
Non-amputees (n=563)	28 (5%)	------	67 (11%)
Amputees (n=45)	-----	15 (33%)	15 (25%)

2nd Follow-up (1995-6 to 1998-9)

Diabetic elders	New amputations	2nd amputations	Deaths
Non-amputees (n=451)	24 (5%)	-----	112 (20%)
Amputees (n=32)	-----	9 (28%)	13 (29%)

Total five-year follow-up (1993-4 to 1998-9)

Diabetic elders	New amputations	2nd amputations	Deaths
Non-amputees (n=630)	52 (11%)	-----	179 (28%)
Amputees (n=60)	-----	24 (40%)	28 (46%)

Source: Otiniano et al. Journal of Diabetes and Its Complications 2003;17:59-65.

Table 12 presents the incidence of new amputations, second amputations and deaths. At the first two-year follow-up, 5% of non-amputees at baseline experienced new amputations and 11% had died. Of amputees at baseline, 33% experienced a second amputation and 25% had died. At the five-year follow-up, 5% of non-amputees experienced a new lower limb amputation and 20% had died. Of amputees at baseline, 28% experienced a second amputation and 29% had died. At the five-year follow-up, there were 52 (11%) new amputees and 28% of non-amputees at baseline had died. Forty percent of persons with an amputation at baseline experienced a second amputation and 46% had died at five-year follow-up. The number of deaths is 60% higher in subjects with an amputation at baseline compared to subjects who never experienced an amputation.

TABLE 13. LOGISTIC REGRESSION ANALYSIS REPORTING ODDS RATIO OF HAVING AMPUTATIONS AT BASELINE AND NEW AMPUTATIONS OVER A FIVE-YEAR PERIOD IN DIABETIC6 MEXICAN AMERICAN ELDERS (N=690)

	Odds ratio of having amputations at baseline (95%CI)	Odds ratio of having new amputations at five-year follow-up (95%CI)	Odds ratio of having amputations at baseline and follow-up (95%CI)
Number of cases with amputations:	60	52	112
Age Group:			
- 65-74	1.0	1.0	1.0
- 75 +	1.12 (0.61-2.04)	0.51 (0.24-1.08)	0.78 (0.48-1.27)
Gender (M vs. F)	2.05 (1.15-3.65)	0.91 (0.49-1.68)	1.39 (0.90-2.15)
Living Alone	1.04 (0.49-2.21)	0.80 (0.35-1.81)	0.90 (0.50-1.61)
Obese ≥30 BMI∗	1.42 (0.80-2.52)	1.76 (0.97-3.21)	1.65 (1.07-2.55)
Eye problems	1.81 (1.04-3.17)	1.16 (0.64-2.11)	1.51 (0.99-2.31)
Stroke	1.66 (0.79-3.52)	3.39 (1.56-7.35)	2.48 (1.39-4.41)
Hip fracture	3.78 (1.30-11.0)	0.60 (0.07-4.86)	2.08 (0.78-5.56)
≥10 years (vs. < 10)	1.96 (1.08-3.55)	1.87 (1.03-3.41)	1.99 (1.28-3.09)

∗ Adjusted for variables listed in table 5 the 89 cases with missing information on obesity were assumed to be "non-obese" cases.

Source: Otiniano et al. Journal of Diabetes and Its Complications 2003;17:59-65.

Table 13 presents the results of logistic regression analysis of amputations at baseline, new amputations at five-year follow-up, and any amputation at both baseline and follow-up. Being male, having eye problems, hip fracture, and diabetes for 10 or more years were associated with lower extremity amputation at baseline. New amputations were associated with stroke and having the disease for 10 or more years. These same variables plus obesity were associated with the overall incidence and prevalence of any amputation during the five-year period of the study.

SUMMARY AND CONCLUSIONS

The estimated prevalence of self-reported diabetes in Mexican American elders was 22%. At the 1st follow-up (1995-1996) there were 532 (23%) diabetic subjects. At the 2nd follow-up (1998-1999) there were 390 (21%) diabetic subjects. At the 3rd follow-up (2000-2001) there were 324 (21%) diabetic subjects. And at the fourth follow-up, there were 265 (23%) subjects with diabetes. The prevalence of diabetes in Mexican American elders is higher than in any other ethnic group. Studies done over the past two decades in Mexican Americas elders (San Antonio Health Study, San Luis Valley Study, Starr County Study, the HHANES, and the Hispanic EPESE) indicated that Mexican Americans elders surpass non-Hispanic White elders and non-Hispanic Black elders in prevalence of diabetes. Data from the HHANES (1982-1984) reported that Mexican Americans aged 45-74 years have a higher prevalence of diabetes than either Non-Hispanic Whites or Non-Hispanic Blacks (92). Data from the National Health Interview survey (NHIS) reported in 1993 that the prevalence of diabetes for non-Hispanic Whites aged 65 years or older was 9.7%, and for non-Hispanic Blacks was 16.2% (81). Data from the 2001 Medicare fee-for-service file of beneficiaries >65 years of age that included four racial/ethnic groups (White, Blacks, Hispanics, and Asians) reported a significantly higher prevalence of diabetes among Hispanics than among Blacks, Asians, or Whites (151).

The estimated prevalence of diabetes complications was 60% in the Hispanic EPESE. From those subjects with complications, thirty-eight percent had retinopathy, 14% reported having nephropathy, 40% had peripheral vascular disease, and 8% had amputations. Diabetic complications were associated with lower education, being unmarried, having the disease for 15 or more years and having certain chronic conditions.

Having any complications (nephropathy, retinopathy, peripheral vascular disease, and amputations) was associated with low education in the San Antonio Heart Study (44) and the San Luis Valley Study (48). Length of the disease was found to be associated with retinopathy and peripheral vascular disease in the San Antonio Heart Study (65, 95, 99, 100, 152), the San Luis Valley Study (48, 110) and the Starr County Study (46, 108).

Diabetic nephropathy refers to the presence of elevated urinary protein excretion in a person with diabetes in the absence of other renal disease (153). The primary constituent of urinary protein in diabetic nephropathy is albumin. Consequently, quantification of urinary albumin excretion is central to any description of diabetic renal disease (153). Diabetes accounts for 44% of all new cases of end-stage renal disease (ESRD) in the United States, and persons with diabetes make up the fastest growing group of renal dialysis and transplants recipients (77, 153). In the Hispanic EPESE we used a self-response to the question “as a result of your diabetes, have you ever had any problem with your kidneys, or not?” to identify nephropathy in people with self-reported history of diabetes. Being male and having insurance were associated with lower risk of nephropathy in the Hispanic EPESE. In the San Antonio Heart Study (42), 26% of Mexican Americans were found to not have any type of health insurance and reported higher rates of microvascular complications (nephropathy and retinopathy). Contrary to reports from the San Antonio Heart Study (62, 95) where Hispanics had lower prevalence of myocardial infarction, in the Hispanic EPESE, heart attack was found to be associated with nephropathy. Previous studies have shown that microalbuminuria is associated with increased risk of death from cardiovascular disease (154). Other factors in the development of diabetes nephropathy include diabetes duration, hypertension, hyperglycemia, and smoking (153).

Diabetic retinopathy is the leading cause of new cases of blindness in people 20-74 years in the United States (155). In the Hispanic EPESE we used a self-response to the question "as a result of your diabetes, have you ever had any problem with your eyes, or not?" to identify retinopathy in people with self-reported history of diabetes. Retinopathy in the Hispanic EPESE was associated with low education, having the disease for 15 or more years and having a heart attack. One previous study reported that the prevalence of retinopathy was 48% in Mexican Americans and increased with the increasing duration of diabetes and increasing levels of HbA_1c (156). Persons who have diabetic retinopathy are 29 times more likely to be blind than non-diabetic persons (155).

Peripheral vascular disease (PVD) is clinically identified by intermittent claudication and/or absence of peripheral pulses in the lower legs and feet. These clinical manifestations reflect decreased arterial perfusion of the extremity (157). In the Hispanic EPESE we used a self-response to the question "as a result of your diabetes, have you ever had any problem with the circulation in your legs or arms, or not?" to identify PVD in people with self-reported history of diabetes. Peripheral vascular disease in the Hispanic EPESE was associated with low education, having the disease for 20 or more years, receipt of insulin or the combination of hypoglycemics and insulin, and having a heart attack. PVD is associated with increasing age and duration of diabetes (157). The prevalence of PVD is higher in diabetic than non-diabetic patients in population-based and clinical based studies (158-160).

Amputations are surgical procedures performed for multiple indications including gangrene, peripheral arterial occlusion, non-healing ulcers, severe soft tissue infections, osteomyelitis, trauma, tumors, and deformities (161). In the Hispanic EPESE we used an observation and self-response to the question "Have you ever had any part of your body amputated as a result of your diabetes, or not?" to identify amputations in people with self-reported history of diabetes. The prevalence of amputations in the Hispanic EPESE was associated with being male, having retinopathy, having hip fracture, and having the disease for 15 years or more. Leg amputation was the most common type of amputation followed by foot amputation. Amputation rates are greater with increasing age, in males compared with females, and among members of racial/ethnic minorities compared with whites (161). In San Antonio, Texas, amputations rates were high for African Americans followed by Mexican Americans and Whites (162). Data from the 1983-90 National Hospital Discharge Surveys (NHDS) indicate that 6% of hospitalizations listing diabetes on the discharge record also listed a lower extremity ulcer condition (161). Clinical epidemiologic studies suggest that foot ulcers precede ~85% of non-traumatic lower extremity amputations in individuals with diabetes (161).

As with prevalence, incidence rates for Hispanics are higher than for whites (81). Incidence studies of diabetes in Non-Hispanic White and Non-Hispanic Black elderly were done in community incidence survey data (Framingham, NHIS, and Rochester) where diabetes is associated with the increase of age (163). Data from the 2001 Medicare fee-for-service beneficiaries >65 years of age file reported that Hispanic elderly have a greatest incidence increase of diabetes (55.0%) than Black, Asian, or White elderly (151). All these surveys exclude institutional individuals, which would bias their estimates downward compared with others. 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 of institutionalized beneficiaries (164).

In the Hispanic EPESE, diabetes complications were followed for 11-years. The incidence of self-reported retinopathy decreased from 15% to 8% at the last follow-up. This decline may have been due to excess deaths in the elderly diabetic population, in which the disease had already progressed to the stage of blindness (155). The relative proportion of cases of blindness attributed to diabetic retinopathy declined with increasing age (155). High blood pressure, early age at onset of diabetes, and longer duration of diabetes are also associated with increased risk of progression of retinopathy (155).

The incidence of self-reported nephropathy in the Hispanic EPESE was steady at 6% during the 4 follow-ups. Longitudinal studies which have been examined the incidence of proteinuria reported that the incidence of proteinuria rises during the early years of diabetes and then declines (153). This finding suggests that only a subset of persons with diabetes is susceptible to renal disease. As the duration of diabetes increases, the number of persons remaining who are susceptible to renal disease declines, resulting in a declining incidence of proteinuria (153).

The incidence of self-reported PVD decreased from 14% to 8% at the last follow-up in the Hispanic EPESE. However, the incidence of PVD increases with age. Many elderly diabetic persons have PVD at the time of diabetes diagnosis (157). Hypertension, smoking, and hyperlipidemia -- frequently present in patients with diabetes -- contribute additional risk for vascular disease (157). In the Rochester, MN study and the Framingham, MA study, the incidence of PVD was higher in men than women. PVD represents a major chronic complication of diabetes and a major health care delivery problem for diabetic patients (157).

The incidence of amputations was 8% at baseline and no amputations at the 11-year follow-up. A potential explanation for no reported amputations at the last follow-up is mortality. In the Hispanic EPESE, mortality among diabetic amputees was 46% during a 5-year follow-up. Serious comorbid conditions are common in this population, and mortality in amputees is often attributed to cardiac or renal complications (165). Eleven percent of Mexican American elders with diabetes who did not have an amputation at baseline reported a lower extremity amputation at 5 year follow-up. New amputations in this group were associated with stroke and having the disease for 10 or more years. Also, 40% of subjects with an amputation at baseline due to diabetes were found to have a second amputation at five-year follow-up. Data from several states indicated that 9%-20% of diabetic individuals experienced a new (ipsilateral) or second leg (contralateral) amputation during a separate hospitalization within 12 months after an amputation (161). Several analytic or experimental studies have demonstrated the beneficial effect of patient education on reducing amputation (161).

CHAPTER 5: HEART ATTACK, STROKE, AND MORTALITY AMONG DIABETICS OVER SEVEN YEARS

HEART ATTACK

In this chapter the impact of self-reported diabetes on heart attack and stroke over a 7-year period was estimated. The results of this chapter have been reported in Otiniano et al. (105, 107, 109)

The analyses reported in Table 14 were adjusted for sampling weights and design effects in order to minimize any clustering bias in our estimates using the SUDAAN program. Logistic regression analyses and Cox proportional hazard analyses were performed using the SAS Program. Logistic regression analyses were used to assess the risk (odd ratio) of having a heart attack at baseline and new heart attack at first, second, and third follow-up; and to assess the risk of having ADL and IADL disabilities in subjects with and without heart attack stratified by other medical conditions at baseline. Cox Proportional Hazard Ratio analysis was employed to estimate the risk of mortality over the 7-year follow-up for people reporting heart attack with and without presence of other risk factors.

Table 14 presents the prevalence of self-reported heart attack and its associated factors among 3050 Mexican American elders at baseline. Age ranged from 65 to 107 years (mean age=73). There were statistically significant differences in the prevalence of heart attack by age (0.01), gender (0.01), health insurance coverage (0.02), smoking (0.01), alcohol consumption (0.01), obesity (0.01), diabetes (0.01), hypertension (0.01), stroke (0.01), hip fracture (0.01), and arthritis (0.01).

TABLE 14. PREVALENCE OF SELF-REPORTED HEART ATTACK AND ASSOCIATED FACTORS AMONG MEXICAN AMERICAN ELDERS AT BASELINE

Variables	No. of subjects at baseline	No. of cases with heart attack (%)	P
Age Group:			
- 65-74	2002	160 (7.9)	0.01
- 75+	1048	118 (11.2)	
Gender:			
- Male	1292	143 (11.7)	0.01
- Female	1758	135 (7.6)	
Health Insurance Coverage:			
- Covered	2815	266 (9.4)	0.02
- Not covered	235	12 (5.1)	
Smoking:			
- Current/Former	1266	135 (10.6)	0.01
- Never	1784	143 (8.0)	
Alcohol consumption			
- Yes	1393	156 (11.2)	0.01
- No	1657	122 (7.3)	
Obesity (BMI≥30)			
- Yes	1010	76 (7.5)	0.01
- No	1759	154 (8.7)	
- Unknown	281	48 (17.0)	
Diabetes:			
- Yes	690	105 (15.2)	0.01
- No	2360	173 (7.3)	
Hypertension:			
- Yes	1250	166 (13.2)	0.01
- No	1800	112 (6.2)	
Stroke:			
- Yes	190	49 (25.7)	0.01
- No	2860	229 (8.0)	
Hip Fracture:			
- Yes	102	21 (20.5)	0.01
- No	2948	257 (8.7)	
Arthritis:			
- Yes	1208	146 (12.0)	0.01
- No	1842	132 (7.1)	
Overall	**3050**	**278 (9.1)**	

Other variables such as marital status, language of interview, living arrangements, financial strain, and depression are not statistically significant, and therefore not listed in the Table.

Source: Otiniano et al. Journal of the American Geriatrics Society 2003;51:923-929

Table 15 presents the prevalence of self-reported heart attack at baseline (9.1%) and incidence rates of self-reported heart attack at first follow-up (6.1%), second follow-up (9.1%), and third follow-up (7.9%).

Table 16 presents logistic regression analyses showing the odds ratio (OR) of having a self-reported heart attack at baseline and at each follow-up, adjusted for socio-demographic factors and other medical conditions. Age (OR 1.38, 95% CI: 1.05-1.80), being male (1.57, 1.18-2.07), having diabetes (1.94, 1.48-2.55), hypertension (2.15, 1.64-2.80), and stroke (2.58, 1.77-3.75) were significantly associated with heart attack at baseline, whereas age was a significant predictor for heart attack during the first (1.52, 1.06-2.17), second (1.69, 1.22-2.34), and third follow-up (1.80, 1.24-2.61). We also performed analyses using age as a continuous variable. As a result, OR for age at the baseline model was 1.02 (1.01-1.03), and ORs for follow-up models were 1.3 (1.01-1.05), 1.05 (1.03-1.07), and 1.06 (1.03-1.09), respectively.

Table 17 presents four different models of the Cox proportional hazard ratio for the effect of heart attack on 7-year mortality. Model 1 presents unadjusted risk ratio (1.57, 95% CI: 1.29-1.91), whereas Model 2 adjusted for age and sex (1.38, 1.13-1.68), Model 3 added social and lifestyle factors (1.39, 1.14-1.69) and Model 4 included other important medical conditions (1.18, 0.97-1.45). All four models demonstrated that subjects with heart attack were significantly more likely to die at 7 years.

TABLE 15. PREVALENCE AND INCIDENCE OF SELF-REPORTED HEART ATTACK AT 7-YEAR FOLLOW-UP

Interview	Cases with heart attack (n)				Cases without heart attack (n)		
	Cases recruited at baseline	Cases of heart attack	Cases who died of heart attack	Cases lost to FU* or died of other causes from this period to the next follow-up	Cases	Cases who died of heart attack	Cases lost to FU or died of other causes from one time period to the next
Baseline (93-94)	3050	278 (9.1)	43	25	2772	32	511
1st Follow-up (95-96)	2261	139 (6.1)	77	8	2122	93	273
2nd Follow-up (98-99)	1849	170 (9.1)	52	9	1679	73	161
3rd Follow-up (00-01)	1518	121 (7.9)	-	-	1397	-	-

∗FU denotes follow-up.

Source: Otiniano et al. Journal of the American Geriatrics Society 2003;51:923-929

TABLE 16. LOGISTIC REGRESSION ANALYSIS REPORTING ODDS RATIO OF SELF-REPORTED HEART ATTACK IN MEXICAN AMERICAN ELDERS AT BASELINE AND EACH FOLLOW-UP.

Variables	baseline*	1st follow-up†	2nd follow-up‡	3rd follow-up§
		Odds Ratio (95%Confidence Interval)		
Age 75 + (vs. <75)	1.38 (1.05-1.80)	1.52 (1.06-2.17)	1.69 (1.22-2.34)	1.80 (1.24-2.61)
Gender (male vs. female)	1.57 (1.18-2.07)	1.38 (0.94-2.01)	0.92 (0.65-1.30)	1.36 (0.91-2.03)
Education (>12 vs. <12)	0.97 (0.64-1.47)	0.66 (0.34-1.28)	0.44 (0.21-0.91)	1.23 (0.69-2.18)
Living arrangements	0.88 (0.63-1.24)	1.08 (0.71-1.65)	1.00 (0.68-1.47)	1.49 (0.98-2.26)
Smoking (ever vs. never)	1.16 (0.89-1.53)	0.68 (0.46-0.99)	1.00 (0.71-1.40)	1.44 (0.98-2.12)
Obesity (BMI>30)	0.78 (0.58-1.04)	0.96 (0.66-1.41)	1.26 (0.90-1.75)	1.38 (0.94-2.04)
Diabetes	1.94 (1.48-2.55)	1.36 (0.92-2.01)	1.80 (1.28-2.54)	0.94 (0.60-1.48)
Hypertension	2.15 (1.64-2.80)	1.22 (0.85-1.74)	1.17 (0.85-1.62)	1.05 (0.72-1.54)
Stroke	2.58 (1.77-3.75)	1.67 (0.95-2.94)	1.44 (0.84-2.49)	1.54 (0.81-2.91)

* Of 3050 cases at baseline, 278 reported to have had a heart attack.

† Of 2772 cases without heart attack at baseline, 139 reported a heart attack at 1st follow-up.

‡ Of 2122 cases without heart attack at 1st follow-up, 170 reported a heart attack at 2nd follow-up.

§ Of 1679 cases without heart attack at 2nd follow-up, 121 reported heart attack at 3rd follow-up.

The logistic regression analyses were adjusted for variables listed in the table.

Source: Otiniano et al. Journal of the American Geriatrics Society 2003;51:923-929

TABLE 17. EFFECT OF SELF-REPORTED HEART ATTACK ON THE 7-YEAR MORTALITY OF MEXICAN AMERICAN ELDERS WITH AND WITHOUT PRESENCE OF OTHER RISK FACTORS.

Models	**Hazard ratio of having 7-year mortality (95% CI)* (n=907)**
Model 1 †	1.57 (1.29-1.91)
Model 2 ‡	1.38 (1.13-1.68)
Model 3 §	1.39 (1.14-1.69)
Model 4 ‖	1.18 (0.97-1.45)

* Generated from the Cox Proportional Hazard regression models of 3050 cases at baseline, 907 died at 7-year follow-up.

† Model 1: heart attack vs. no heart attack, without adjusting for other variables.

‡ Model 2: heart attack vs. no heart attack, adjusting for age and sex.

§ Model 3: heart attack vs. no heart attack, adjusting for variables used in Model 2, plus social and lifestyle factors (living arrangements, smoking, and drinking).

‖ Model 4: heart attack vs. no heart attack, adjusting for variables used in Model 3, plus chronic conditions (obesity, diabetes mellitus, hypertension, stroke, cancer, hip fracture, and arthritis).

Source: Otiniano et al. Journal of the American Geriatrics Society 2003;51:923-929

STROKE

Univariate analyses of the effect of diabetes and stroke in association with socio-demographic characteristics and other factors were conducted using chi-square tests. These analyses adjusted for sampling weights and design effects to remove any clustering bias in our estimates, using the SUDAAN program (150). Odds ratios (95% confidence intervals) generated from logistic regression analyses were used to assess the risk of having fair or poor self-rated health across the four groups of subjects. Five-year survival analysis was undertaken using the Cox proportional hazard regression model (166). The dates of deaths among subjects across two waves of follow-ups were determined from family members and a mortality search performed by Epidemiology Resources Inc.

Table 18 shows the prevalence and incidence of stroke at the total of 11-year follow-up. At baseline there were 6% cases with stroke, at the 1st follow-up there were 6%, at the 2nd follow-up were 5%, at the 3rd follow-up were 4%, and at the 4th follow-up were 7% new cases who reported self-reported diagnosed stroke. At follow-up, a higher percentage of stroke cases combined with diabetes had died compared to stroke cases only.

TABLE 18. PREVALENCE AND INCIDENCE OF STROKE AT 11-YEAR FOLLOW-UP

Interview	Cases recruited at baseline	Cases of stroke	Cases who died of stroke	Cases who died having diabetes
Baseline (93-94)	3050	190 (6%)	---	---
1st Follow-up (95-96)	2261	134 (6%)	25 (13%)	17 (22%)
2nd Follow-up (98-99)	1849	84 (5%)	27 (20%)	16 (35%)
3rd Follow-up (00-01)	1518	60 (4%)	22 (26%)	8 (24%)
4th Follow-up (04-05)	1167	88 (7%)	21 (35%)	12 (52%)

Table 19 presents socio-demographic factors across 4 groups: those with both diabetes and stroke, those with stroke but no diabetes, those with diabetes but no stroke, and those with neither at baseline. There were statistically significant differences across the 4 groups in age, language of interview, health insurance coverage, living arrangement and financial strain.

TABLE 19. SELECTED SOCIO-DEMOGRAPHIC CHARACTERISTICS AT BASELINE FOR SUBJECTS WITH OR WITHOUT DIABETES OR STROKE

	Total	Diabetes + Stroke (n=76)	No Diabetes + Stroke (n=114)	Diabetes + No Stroke (n=614)	No Diabetes + No Stroke (n=2246)	p*
Age Group:						
- 65-74	2002	42 (55)†	49 (42)	452 (73)	1459 (64)	<0.01
- 75 +	1048	34 (44)	65 (57)	162 (26)	787 (35)	
Gender:						
- Male:	1298	41 (57)	49 (40)	250 (42)	952 (42)	0.39
- Female:	1758	35 (42)	65 (59)	364 (57)	1294 (57)	
Marital Status:						
- Married:	1693	41 (50)	67 (56)	360 (59)	1225 (54)	0.41
- Unmarried:	1357	35 (49)	47 (43)	254 (40)	1021 (45)	
Levels of Education:						
- < 5	1601	42 (53)	57 (41)	339 (51)	1211 (50)	0.36
- 5-11	1102	21 (25)	46 (40)	215 (37)	820 (39)	
- ≥12	299	13 (20)	11 (17)	60 (11)	215 (9)	
Language of Interview:						
- Spanish:	676	48 (54)	78 (60)	488 (73)	1760 (73)	0.02
- English:	2374	28 (45)	36 (39)	126 (26)	486 (26)	
Health Insurance:						
- Covered:	2815	74 (98)	109 (95)	582 (93)	2050 (87)	<0.01
- Not covered:	235	2 (2)	5 (5)	32 (6)	196 (12)	
Living Arrangements:						
- Alone:	640	13 (13)	17 (17)	113 (17)	497 (22)	0.04
- With others:	2410	63 (86)	97 (82)	501 (82)	1749 (77)	

Financial Strain:						
- None/a little:	1441	51 (68)	66 (62)	259 (46)	1065 (51)	0.01
- A great deal:	1609	25 (31)	48 (37)	355 (53)	1181 (48)	

* x^2 statistical test. † column percent weighted.

Source: Otiniano et al. Archives Physical Medicine Rehabilitation 2003;84:725-30

Table 20 presents data on health related variables across the four groups. Differences were found for obesity, hypertension, heart attack, arthritis, hospitalization in the past year, having a doctor visit in the past 12 months, reporting fair/poor health, any ADL disability, and any IADL disability across the four groups.

TABLE 20. HEALTH-RELATED CHARACTERSITICS AT BASELINE FOR SUBJECTS WITH OR WITHOUT DIABETES OR STROKE

	Total	**Diabetes + Stroke** (n=76)	**No Diabetes + Stroke** (n=114)	**Diabetes + No Stroke** (n=614)	**No Diabetes + No Stroke** (n=2246)	**p***
Current/ever Smoker:	1266	39 (44)†	53 (48)	245 (40)	929 (43)	0.58
Obesity (BMI:30+):	1010	17 (20)	23 (16)	243 (42)	727 (31)	<0.01
Hypertension:	1250	47 (62)	75 (69)	347 (55)	781 (36)	<0.01
Heart Attack:	278	23 (37)	26 (17)	82 (12)	147 (6)	<0.01
Cancer:	162	5 (7)	11 (8)	38 (9)	108 (5)	0.11
Hip Fracture:	102	6 (10)	10 (19)	17 (2)	69 (3)	0.08
Arthritis:	1208	42 (58)	53 (52)	296 (47)	817 (37)	0.01
Hospitalization‡:	579	37 (55)	39 (42)	152 (25)	351 (14)	<0.01
Doctor's visits‖:	2460	69 (93)	101 (90)	565 (91)	1725 (75)	<0.01
Fair/Poor Health	1402	41 (45)	70 (50)	408 (66)	1129 (47)	<0.01
Any ADL:	418	38 (58)	45 (45)	103 (15)	232 (10)	<0.01
Any IADL:	1622	69 (91)	88 (78)	370 (62)	1095 (51)	<0.01

* x^2 statistical test.
† percent weighted.
‡: Hospitalized in the past 12 months.

‖: Visited physician in the past 12 months.

Source: Otiniano et al. Archives Physical Medicine Rehabilitation 2003;84:725-30

Table 21 presents both unadjusted and adjusted odds ratios of having fair or poor self-rated health across the four groups. Compared to subjects without diabetes and stroke, subjects with diabetes but no stroke were nearly two times more likely to rate their health as fair or poor, whereas subjects with stroke but no diabetes were over two-fold more likely to rate their health as fair or poor. Subjects with both diabetes and stroke were over three times as likely to do so.

TABLE 21. EFFECT OF DIABETES AND STROKE ON SELF-RATED HEALTH IN MEXICAN AMERICAN ELDERS

Combination of diabetes and stroke	Number (%) of subjects	Odds ratio (95% CI) of having fair or poor self-rated health	
		Unadjusted odds ratio	Adjusted* odds ratio
No Diabetes + No Stroke	2246 (73.6)	1.00	1.00
Diabetes + No Stroke	614 (20.1)	2.33 (1.89-2.87)	1.98 (1.58-2.49)
No Diabetes + Stroke	114 (3.7)	3.80 (2.16-6.69)	2.70 (1.48-4.93)
Diabetes + Stroke	76 (2.5)	5.56 (2.35-13.16)	3.52 (1.44-8.65)

* Adjusted for age, gender, education, living arrangements, current or ever smoker, obesity, hypertension, heart attack, cancer, hip fracture, and arthritis.

Source: Otiniano et al. Archives Physical Medicine Rehabilitation 2003;84:725-30

Table 22 presents the proportional hazard regression analysis of 5-year mortality for those with diabetes, stroke, or both, as compared to those with neither condition. Those with both diabetes and stroke were over twice as likely to die within 5 years as those without diabetes and stroke (hazard ratio of 2.42 with 95% CI: 1.70-3.45).

TABLE 22. EFFECT OF DIABETES AND STROKE IN THE 5-YEAR MORTALITY IN MEXICAN AMERICAN ELDERS

Combination of diabetes and stroke	Number (crude death rate %) of deaths	Hazard ratio (95% CI) of the 5-year mortality	
		Unadjusted	Adjusted*
No Diabetes + No Stroke	375 (16.6)	1.00	1.00
Diabetes + No Stroke	174 (28.3)	1.81 (1.51-2.16)	1.96 (1.63-2.36)
No Diabetes + Stroke	45 (39.4)	2.40 (1.76-3.26)	1.44 (1.07-2.03)
Diabetes + Stroke	35 (46.0)	3.13 (2.22-4.43)	2.42 (1.70-3.45)

* Adjusted for age, gender, education, living arrangements, current or ever smoker, obesity, hypertension, heart attack, cancer, hip fracture, and arthritis.

Source: Otiniano et al. Archives Physical Medicine Rehabilitation 2003;84:725-30

MORTALITY

Univariate analyses of the relationship between vital status and diabetic complications were performed by using the Mantel-Haenszel chi-square statistics. Survival analyses examining the effect of diabetic complications on 7-year mortality were conducted using the Cox Proportional Hazard regression model. Variables listed in Table 24 were used to model selected complications (retinopathy, nephropathy, peripheral vascular disease, and amputations) over the 7-year study period. Table 25 shows the Cox Proportional Hazard ratio of subjects who had one, two, three, or four complications (166) compared to subjects without diabetic complications. The SUDAAN program was used to adjust for sample design effects (150). In these analyses, subjects who were lost to follow-up or were still alive on the last date of follow-up (December 2001) were censored. These analyses were completed using the SAS program (SAS Institute Inc, Cary, NC).

TABLE 23. DEMOGRAPHIC AND HEALTH CHARACTERISTICS OF MEXICAN AMERICAN ELDERS WITH DIABETES WHO DIED BY 7-YEAR FOLLOW-UP (N=690)

	Total N	Row % of subjects who died at 7 years	P
Overall:	690	39.7	
Age Group:			
- 65-74	494	32.5	<0.01
- 75-84	166	54.2	
- ≥ 85	30	76.7	
Gender:			
- Male	291	46.4	0.03
- Female	399	35.0	
Body Mass Index:			
- <22	133	56.3	<0.01
- 23-26	194	42.2	
- 27-29	145	35.8	
- >=30	218	30.7	
Smoking			
- Ever smoked	284	43.3	0.11
- Never smoke	406	37.2	
Drinking			
- Ever drank	311	41.8	0.31
- Never drank	379	38.0	
Living arrangement			
- Alone	126	39.7	0.99
- With others	564	39.7	
Year of diagnosis with diabetes			
- <10 years	297	37.0	0.17
- 10-19 years	193	42.5	
- >=20 years	148	38.5	
- Unknown	52	48.1	

Complications:			
- Any Complications	412	45.3	<0.01
- No Complications	278	32.0	
Selected Complications:			
- Eye problems:	269	46.4	0.07
- Kidney problems:	99	54.5	<0.01
- Circulation problems:	280	45.3	0.02
- Amputations:	62	56.4	0.02
Comorbidities:			
- Stroke:	76	53.9	0.05
- Heart Attack:	105	45.7	0.02
- Hypertension	394	41.6	0.34
- Hip Fracture	23	65.2	0.14
- Depression	186	44.0	0.71

Source: Otiniano et al. J Diabetes and its Complications 2003;17:243-248

Of 690 subjects aged 65 or older with diabetes, 276 (40%) subjects died between baseline and 7-year follow-up (Table 23). The death rate significantly increased with age and was higher in men than in women. Patients with diabetic complications had a higher death rate (45%) than those without complications (32%).

Table 24 presents a series of models of the effect of each separate diabetic complication (retinopathy, nephropathy, peripheral vascular disease, or amputation) on 7-year mortality. The first model was unadjusted; the second model adjusted for age and sex. The third model included social and lifestyle factors such as living arrangement, smoking, and drinking. Other chronic diseases such as hypertension, stroke, heart attack, cancer and hip fracture were added in the fourth model. Patients with Nephropathy were statistically significantly more likely to die than those without Nephropathy in all four models (e.g., the final adjusted hazard ratio was 1.56 with 95% confidence interval of 1.13-2.16). In adjusted models for the other three complications, the hazard ratio was not statistically significant, except for amputations in the unadjusted model (1.64, 1.11-2.43).

TABLE 24. EFFECT OF DIABETES COMPLICATIONS ON 7-YEAR MORTALITY IN MEXICAN AMERICAN ELDERS

	Hazard ratio (95% confidence interval) of the 7-year mortality			
	Model 1∗	**Model 2†**	**Model 3‡**	**Model 4§**
Retinopathy	1.23 (0.95-1.59)	1.28 (0.99-1.65)	1.29 (1.00-1.68)	1.26 (0.97-1.63)
Nephropathy	1.62 (1.18-2.23)	1.60 (1.16-2.21)	1.58 (1.15-2.19)	1.56 (1.13-2.16)
PVD	1.04 (0.79-1.38)	1.09 (0.82-1.44)	1.11 (0.84-1.48)	1.09 (0.83-1.45)
Amputations	1.64 (1.11-2.43)	1.33 (0.89-1.98)	1.30 (0.87-1.94)	1.32 (0.87-1.99)

Note: Hazard ratio (95% confidence interval) was generated from the Cox Proportional Hazard regression models.
∗ Model 1: Diabetic mortality without adjusting for other variables.
† Model 2: Diabetic mortality adjusting for age and sex.
‡ Model 3: Diabetic mortality adjusting for variables used in Model 2, plus social and lifestyle factors (living arrangements, smoking, and drinking).
§ Model 4: Diabetic mortality adjusting for variables used in Model 3, plus other diseases (stroke, heart attack, hypertension, cancer, hip fracture).

Source: Otiniano et al. J Diabetes and its Complications 2003;17:243-248

Table 25 presents detailed information on diabetic complications and their association with 7-year mortality. Status of diabetic complications was classified into 5 distinct groups: having no complication, showing only one complication, and having two, three or four complications. In each group, there were also several distinct combinations of different complications present in patients. For example, 9% of patients with diabetes had three complications present at the time of interview, and 2% had all 4 selected complications as shown in the second column of Table 25.

The third column of Table 25 presents the Cox proportional hazard ratio which estimated the effect of the number of diabetic complications on 7-year mortality. Compared to subjects without any diabetic complications, subjects with only one complication were not statistically significantly different with respect to 7-year mortality. However, those with 2 or 3 complications were nearly twice as likely to die within 7 years than those without complications, while patients with 4 complications were nearly 3 times more likely to die (hazard ratio: 2.86 with 95% confidence interval of 1.47-5.58).

The fourth column of Table 25 presents the effect of each unique combination of diabetic complications on mortality. For example, patients with kidney problems were significantly more likely to die than those without complications, as were those with eye plus circulation, circulation plus amputation, and kidney plus eye plus circulation problems.

TABLE 25. EFFECT OF SELF-REPORTED DIABETES COMPLICATIONS ON 7-YEAR MORTALITY IN MEXICAN AMERICAN ELDERS

		Hazard ratio (95% confidence interval) of the 7-year mortality†	
Diabetic Complications	**N**	**Major group of combination**	**Individual combination of complications**
Subjects with no complications	278	1.00 (reference)	1.00 (reference)
Subjects with one complication only		1.30 (0.96-1.76)	
Eyes	101		1.38 (0.95-1.99)
Kidney	20		1.95 (1.03-3.70)
Circulation	82		1.05 (0.68-1.62)
Amputations	0		
Subjects with two complications		1.75 (1.26-2.43)	
Eyes + Circulation	82		1.57 (1.06-2.32)
Circulation + Amputation	26		2.22 (1.29-3.83)
Kidney + Circulation	14		1.85 (0.84-4.04)
Kidney + Eye	11		2.02 (0.73-5.54)
Subjects with three complications		1.80 (1.17-2.79)	
Kidney + Eyes + Circulation	40		2.21 (1.34-3.66)
Eyes + Circulation + Amputation*	23		1.24 (0.60-2.58)
Subjects with four complications	13	2.86 (1.47-5.58)	2.86 (1.46-5.57)
Total	690		

* One complication case (kidney + circulation + amputation) was added at this group.

† Hazard ratio (95% confidence interval) was generated from the Cox proportional hazard regression models, and adjusted for age, sex, living arrangements, smoking, drinking, past medical history of stroke, heart attack, hypertension, cancer, and hip fracture.

Source: Otiniano et al. J Diabetes and its Complications 2003;17:243-248

Table 26 shows causes of death among Mexican American elders in association with various diabetic complications. Heart attack was the primary underlying cause of death in patients with diabetes with or without complications. For example, heart attack was reported in 42% of cases with retinopathy and 57% of patients with nephropathy plus peripheral vascular disease. Cancer and pneumonia were the second and third most common underlying causes of death reported by family members.

TABLE 26. CAUSES OF DEATH REPORTED BY FAMILY MEMBERS IN MEXICAN AMERICAN ELDERS WITH VARIOUS DIABETES COMPLICATIONS

Diabetic complications	No. (%)	Heart Attack	Cancer	COPD Pneumonia	Stroke	Diabetes complication	Alzheimer disease	Injury	Other causes
No Complications	89 (32.4)†	35.9‡	13.4	8.9	7.8	4.4	2.2	0	26.9
One Complication only									
Eyes	43 (15.6)	41.8	16.2	9.3	11.6	2.3	0	0	18.6
Kidney	11 (4.0)	27.2	27.2	9.0	18.1	9.0	0	0	9.0
Circulation	27 (9.8)	33.3	14.8	3.7	7.4	11.1	0	0	29.6
Amputations	0	0	0	0	0	0	0	0	0
Two Complications									
Eyes + Circulation	38 (13.8)	39.4	21.0	5.2	5.2	7.8	0	0	21.0
Circulation + Amputation	16 (5.8)	31.2	6.2	6.2	12.5	6.2	0	0	37.5
Kidney + Circulation	7 (2.5)	57.1	28.5	0	14.2	0	0	0	0
Kidney + Eye	4 (1.4)	0	0	0	0	25.0	0	0	75.0
Three Complications									
Kidney + Eyes + Circu.	20 (7.3)	40.0	10.0	0	5.0	20.0	0	0	25.0
Eyes + Circu.+ Amput.*	8 (2.9)	25.0	0	12.5	0	12.5	0	12.5	37.5
Four Complications	11 (4.0)	45.4	9.0	0	0	9.0	0	0	36.3
Total	274 (100)								

* One complication case (kidney + circulation + amputation) was added at this group.
† Column percent.
‡ Row percent.

Source: Otiniano et al. J Diabetes and its Complications 2003;17:243-248

SUMMARY AND CONCLUSIONS

The purpose of this section was to describe the summary and conclusions of the findings of self-reported diabetes on heart attack, stroke, and mortality over a 7-year period. These findings have been reported in Otiniano et al. (105, 107, 109)

The prevalence and incidence of self-reported heart attack in each of the 3 follow-ups in Mexican American elders was described above. Of the 690 diabetics, approximately 15% reported a heart attack at baseline. However, from those subjects without diabetes, the prevalence of heart attack decreased significantly to 7%. Factors such as age, gender, diabetes, hypertension, and stroke were significantly associated with heart attack at baseline, whereas age was a significantly predictor for incident heart attack at 7-year follow-up. Fifty-six percent of the 690 diabetics Mexican American elders reported also having hypertension at baseline. Based on the 1989 U.S. National Health Interview Survey (NHIS), 20% of those age ≥65 years who reported having diabetes also reported ischemic heart disease (167). Heart disease in diabetic individuals appears early in life, affects women almost as often as men, and is more often fatal (167).

This study also found that increased age was not only significantly associated with heart attack at baseline, but also a significantly predictor for self-reported heart attack at each of the three subsequent follow-ups. An interesting finding here was that some already known risk factors for heart attack such as diabetes, hypertension and stroke were significantly associated with self-reported heart attack at baseline, as other studies showed (14, 168-172), but were not significant predictors of self-reported heart attack at the three follow-ups in Mexican American elders. A possible reason was that the number of cases with heart attack at follow-ups was small. In this situation, the association was unlikely to show statistical significance.

Incidence of heart disease in population-based studies in diabetic and non-diabetic White adults were done in the Wisconsin Study (173), Rancho Bernardo Study (174), Nurses Health Study (175), and others which reported that the risk of fatal ischemic heart disease was significantly greater among those with diabetes than those without.

Diabetic individuals who have had a myocardial infarction are more likely than non-diabetic people to experience another infarction or death (167). People with self-reported heart attack from the Hispanic EPESE have a greater risk of dying within 7-year follow-up. Heart attack was the underlying cause of death for 42.4% of those who died. The most common cause of death in adults with diabetes is coronary heart disease (167). National incidence data from a 9-year follow-up of the 1971-75 NHANES I for people with diabetes age 40-77 years showed a death rate of 28 per 1,000 persons-years for men and 10 per 1,000 persons-years for women respectively (167).

In conclusion, Mexican American elders with self-reported heart attack were more likely to be older, be male, and have history of diabetes, hypertension and stroke. Subjects with self-reported heart attack had a greater risk of disabilities and were more likely to have died by the 7-year follow-up.

Data from the Hispanic EPESE reported the summary and conclusions of the findings of self-reported diabetes on stroke over 7-year period. Part of these findings have been reported in Otiniano et al. (107)

Diabetes is an important cause of stroke (123). Of the 690 diabetics in the Hispanic EPESE at baseline, approximately 12% reported ever having a stroke. However, only 5% reported having stroke without diabetes. Elevated blood pressure is the major risk factor for stroke. Fifty-six percent of the 690 diabetic Mexican American elders also reported having hypertension. Other risk factors for stroke besides diabetes include cigarette smoking and a high level of low-density lipoprotein (LDL) cholesterol (123).

These findings show that the presence of both diabetes and stroke substantially increase the odds of reporting fair/poor self-rated health, and dying within five years. The effects of diabetes and stroke on self-rated health and mortality were cumulative. Although the presence of other medical conditions also increased these risks, the effect of diabetes with presence of stroke was substantial, even after stratifying for other chronic conditions or adjusting for other conditions simultaneously in the models. A common indicator of health perception is self-rated health. In this study, respondents with diabetes and stroke were significantly more likely to rate their health as fair or poor. This pattern contrasts with the responses of the group without these diseases, even after adjustment for age, gender, education, living arrangements, smoking, obesity, hypertension, heart attack, cancer, hip fracture, and arthritis.

The incidence of stroke from the Hispanic EPESE at 7-year follow–up was 4% and increased to 7% at 11-year follow-up. The incidence of stroke also increased with increasing age. In addition, mortality of the combination of diabetes and stroke at 7-year follow-up was 24% and at 11-year follow-up was 52%. Many stroke patients may have undetected diabetes at the time of stroke; subsequent examination in the hospital or following treatment for stroke may identify previously undetected diabetes (123).

Mortality in subjects with both diseases was two and a half-fold compared to those without these diseases over five-years. These results are consistent with other studies (176-178), including the Multiple Risk Factor Intervention Trail (MRFIT) that found 2.8-fold risk of mortality in subjects with diabetes and stroke (169). Persons with diabetes may have a worse prognosis after a stroke (123). Data from the National Center for Health Statistics in 1992 reported stroke deaths higher in African Americans than Whites or Hispanics (123).

In conclusion, these findings suggested that Mexican American elders with diabetes and stroke have significantly higher rates of disabilities, poorer self-rated health, and higher mortality than persons without these diseases, regardless of the presence of other conditions. The effect of diabetes with stroke on the outcomes seems to follow an additive model.

Here is the summary and conclusions of the findings of self-reported diabetes on mortality over a 7-year period. These findings have been reported in Otiniano et al. (109)

The study found that subjects with diabetic complications were significantly more likely to die than those without complications, particularly subjects with more than 2 self-reported complications at the time of baseline interview. There is evidence that indicates that diabetes ranks higher as a cause of death in racial/ethic minority populations than in Whites in the United States (179).

Mexican American elders with nephropathy were nearly twice as likely to die than subjects without diabetic complications. It is likely that the development of diabetic nephropathy is indicative of a generalized worsening that leads to higher mortality. Diabetic end-stage renal disease rates have been shown to be higher in Mexican Americans than in non-Hispanic whites (111, 180, 181).

Most studies of mortality in persons with diabetes have been conducted in White and Black populations (179). As in general populations, mortality in persons with diabetes increases with age (179). One study on mortality data from the 2001 Medicare fee-for-service beneficiaries of people >65 years of age included four racial/ethnic groups (White, Blacks, Hispanics, and Asians) reported lower mortality rates among Hispanics and Asians with diabetes than among White and Black elders. These reports are consistent with lower mortality rates found among those without diabetes (151), reports of all cause of mortality reported by the National Center for Health Statistics (182), and the recent report of Bertoni et al. using Medicare data from 1995 to 1999 (183).

The four leading causes of death in persons with diabetes are cardiovascular disease, diabetes, malignant neoplasms, and cerebrovascular disease (179). Heart attack is the most commonly reported cause of death in diabetic Mexican American elders in this study. Heart attacks accounted for 45% of deaths among diabetic Mexican Americans with four complications, followed by cancer, stroke, and diabetic complications. Over 15% of patients with diabetes had a history of heart attack and 11% had a history of stroke in this study.

Among middle-aged populations with diabetes, life expectancy is reduced by 5-10 years. Reduction of life expectancy is greater for those with diabetes complications, and decreases with increasing age at diagnosis (179). The excess risk of mortality is also higher for those using insulin, which may be an indicator of more severe disease (179).

In conclusion, the risk of 7-year mortality increased with the number of complications in Mexican American elderly patients with diabetes. Detection of and early treatment/control for diabetic complications may lead to increase survival in this population. Modifying or preventing risk factors through the promotion of healthy lifestyles could decrease diabetes mortality.

CHAPTER 6: DIABETES AND GLYCEMIC CONTROL

This section described the results of self-reported diabetes on glycemic control over 11-year period.

In the 5th interview, a sample of 902 Mexican Americans aged 75 years old was added. An HbA_1c test to measure glycemic control for diabetics was incorporated into the study. These data are from the 5th interview (2004-2005). A total of 2,069 Mexican Americans aged 75 and over were interviewed. Six-hundred eighty nine subjects (33%) reported having been diagnosed with diabetes and 209 (30%) subjects agreed to perform a finger prick and supply a dry blood sample to test their HbA_1c level.

Statistical analysis focuses on the association between poor glycemic control and sociodemographic and health factors. Differences across sociodemographic and health factors were assessed with chi-square statistics (Tables 27 and 28). Statistical analysis between poor glycemic control and compliance and patient knowledge was assessed by chi-square statistics (Table 29). Odds ratios and 95% confidence intervals generated from logistic regression analysis were used to assess the risk of poor glycemic control in Mexican American elders with diabetes (Table 30). These analyses were completed using the SAS program (SAS Institute Inc, Cary, NC).

The HbA_1c test provides the most objective and reliable information about long-term glucose control in diabetic patients (184, 185). The HbA_1c test measures a person's average glycemia over the preceding 2-3 months (186) and thus assesses treatment effectiveness (20). Values for HbA_1c are expressed as a percentage of total hemoglobin. The value of HbA_1c in people without diabetes typically ranges from 4% to 6% (187). Diabetics with a normal range of HbA_1c reflect better metabolic control of the disease

(188). The American Diabetes Association (ADA) recommends the use of HbA_1c as a baseline test before initiating therapy (20, 192) and the HbA_1c remains a valuable test for monitoring glycemia (189, 190). The ADA recommends that the goal of therapy should be an HbA_1c result of $\leq$7% (20, 189). Additional action is recommended to improve glycemic control when HbA_{1C} reaches 8% (20, 191).

There have been a few epidemiologic studies of HbA_1c collected from finger prick or blood samples in Mexican Americans. For example, Ferrell et al. (188) found no gender differences, both in newly diagnosed diabetics and in those with a clinical history of diabetes (neither diabetics taking medications nor those not taking medications, or those diabetics taking insulin with those taking pills). Lasater et al. (192) found that glycemic control in Hispanics was not related to the ability to speak English. Harris et al. (191) using HHANES III data found poor glycemic control (>8%) in non-Hispanic black women (50%) and Mexican American men (45%) compared with other groups. Finally, Tucker et al. (197) found that older Hispanics of Caribbean origin were more likely to have glycosylated hemoglobin concentrations above 7% than non-Hispanic Whites. These data indicate that Mexican Americans and other Hispanics with diabetes may have poor glycemic control, placing them at high risk of diabetic complications (188, 194).

Figure 4 describes the 5th interview distribution of H-EPESE subjects by diabetes status, HbA_1c test lab receiving, and processing. From 2,069 Mexican American elders interviewed at the 5th wave, 689 (33%) reported having diabetes. At the interview time, 413 subjects agreed to perform a finger prick test for HbA_1c; however 40% of them never did the test. Only 250 HbA_1c test kits were received by the lab. Of these, 84% of test kits were usable for processing.

FIGURE 4. FIFTH WAVE DISTRIBUTION OF THE HISPANIC EPESE BY DIABETES, HBA_1C TEST LAB RECEIVING, AND PROCESSING

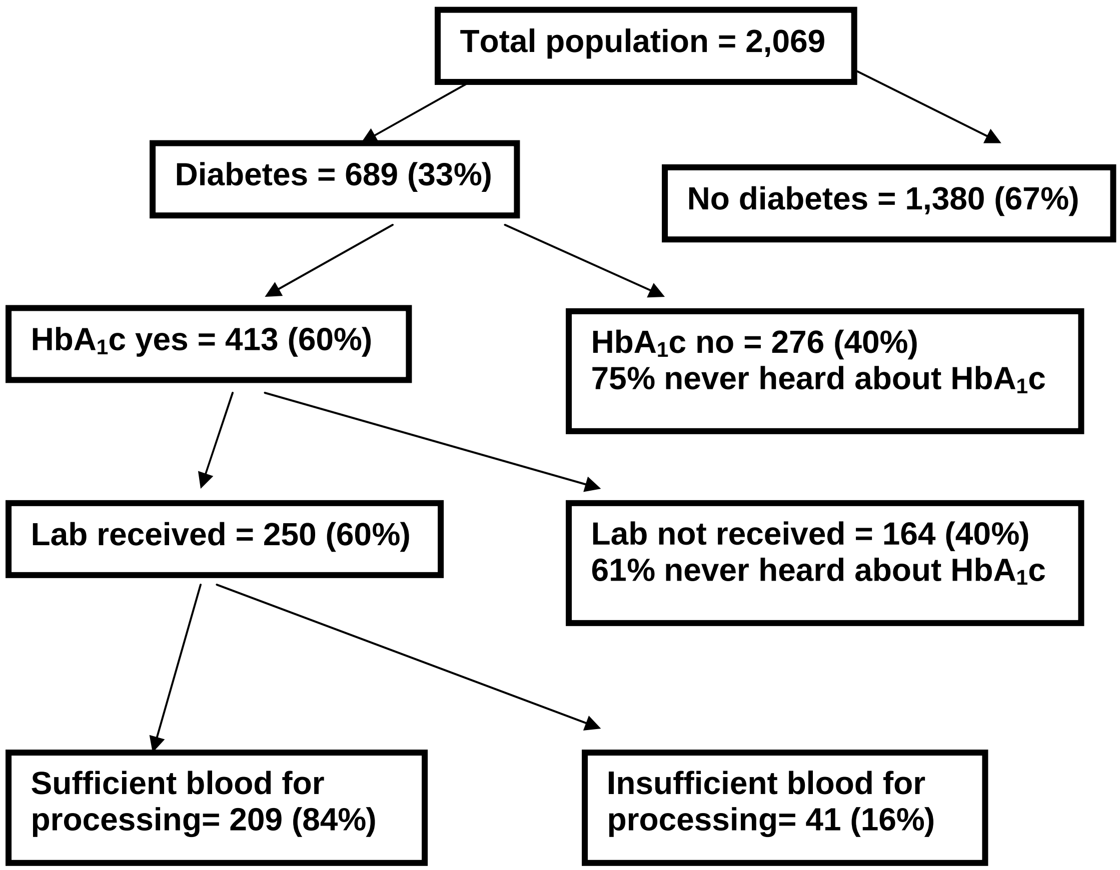


Table 27 shows socio-demographic characteristics of Mexican American elders who had good and poor glycemic control. Of the 209 diabetic subjects who performed an HbA_1c, 132 (63%) subjects had good glycemic control (HbA_1c <7%) and 37% had poor glycemic control (HbA_1c >8%) (p=<.0001). There is no statistical significance in sociodemographic variables between these groups.

TABLE 27. HBA$_1$C MEASUREMENT AND SOCIO-DEMOGRAPHIC CHARACTERISTICS OF MEXICAN AMERICAN ELDERS 75 AND OLDER WITH DIABETES (N=209)

Characteristics	Good glycemic control HbA$_1$c <7.9% n=132 (63%)	Poor glycemic control HbA$_1$c >8% n=77 (37%)	p
HbA$_1$c mean ± SD	6.8 ± 0.66	9.57 ± 1.64	<.0001
Age			0.06
75 – 79	63 (57%)*	47 (43%)	
>80 +	69 (70%)	30 (30%)	
Sex			0.53
Male	52 (66%)	27 (34%)	
Female	80 (62%)	50 (38%)	
Education			0.10
<7 grade	91 (60%)	61 (40%)	
≥8 grade	41 (72%)	16 (28%)	
Marital status			
Married	58 (60%)	38 (40%)	0.44
Unmarried	74 (65%)	39 (35%)	
Language			
Spanish	96 (62%)	59 (38%)	0.53
English	36 (67%)	18 (33%)	
Living arrangements			0.90
Alone	37 (64%)	21 (36%)	
With others	95 (63%)	56 (37%)	
Income			0.45
<15,000	85 (62%)	53 (38%)	
>15,000	39 (67%)	19 (33%)	
Smoke			
Yes	63 (61%)	40 (39%)	0.55
No	69 (65%)	37 (35%)	
Drink			
Yes	80 (65%)	44 (35%)	0.62
No	52 (61%)	33 (39%)	

* Row percent

TABLE 28. HBA$_1$C MEASUREMENT AND MEDICAL CHARACTERISTICS OF MEXICAN AMERICAN ELDERS 75 AND OLDER WITH DIABETES (N=209)

Characteristics	Good glycemic control HbA$_1$c <7.9% n=132	Poor glycemic control HbA$_1$c >8% n=77	P
Self-rated health			0.79
Fair/poor	99 (63%)	59 (37%)	
Excellent/good	33 (65%)	18 (35%)	
BMI mean ± SD	28.4 ± 4.6	28.0 ± 4.7	0.59
DM complications			
Eye problems	47 (58%)	33 (41%)	0.29
Kidney problems	21 (75%)	7 (25%)	0.16
Circulation problems	53 (58%)	38 (42%)	0.19
Amputations*			
Length of disease			0.001
<10 years	67 (76%)	21 (23%)	
>11 years	61 (54%)	52 (46%)	
Receive treatment			0.008
None	18 (81%)	4 (18%)	
Pills	95 (66%)	50 (34%)	
Insulin	19 (45%)	23 (55%)	
Polypharmacy mean ± SD	11.5 ± 3.7	11.3 ± 3.7	0.70
Comorbidities			
Stroke	29 (64%)	16 (36%)	0.83
Heart attack	29 (58%)	21 (42%)	0.38
Hypertension	99 (66%)	51 (34%)	0.18
Physical function			
Any ADL	53 (65%)	29 (35%)	0.72
Any IADL	112 (64%)	63 (36%)	0.56
Walking speed mean±SD	6.3±3.5	7.0±4.2	0.34
MMSE† score mean ± SD	20.2 ± 4.9	19.7 ± 6.3	0.58

∗ Amputations were excluded because only 4 subjects reported being amputees.
† Mini Mental State Examination

Table 28 details the medical factors of subjects: self-rated health, BMI, diabetes complications, length of disease, treatment received, polypharmacy, related comorbidities, physical function, physical activity, and cognition. Bivariate analysis reported that subjects with poor control have longer disease duration ($p=0.001$) and are more likely to use insulin ($p=0.008$) compared to subjects with good glycemic control.

FIGURE 5. DISTRIBUTION OF DATA FROM SUBJECTS AND HBA$_1$C %

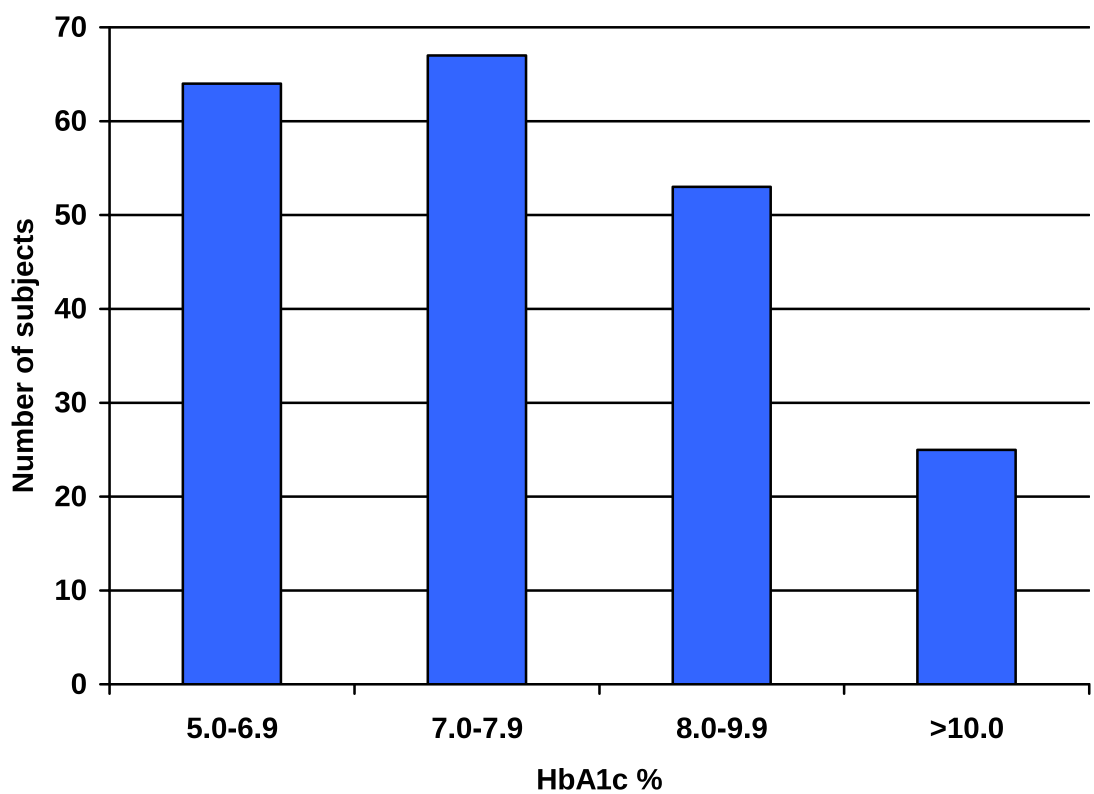


Figure 5 shows the distribution of subjects by HbA$_1$c category. Thirty-one percent of subjects are in the category of 5.0-6.9%, 32% in the 7.0-7.9% category, 25% in the 8.0-9.9%, and 12% of subjects are in the >=10% of HbA$_1$c.

Table 29 shows the glycemic control compliance of Mexican American elders with diabetes who had either good or poor glycemic control. There is no difference in glucometer use between groups, although those in the good glycemic control group ($p=0.01$) test their blood glucose more frequently. Also, there is no difference in special diet for diabetes, subject knowledge of the HbA_1c test, yearly measure of HbA_1c, doctor visits or hospitalization between groups.

TABLE 29. GLYCEMIC CONTROL COMPLIANCE OF MEXICAN AMERICAN ELDERS 75 AND OLDER WITH DIABETES (N=209)

Characteristics	Good glycemic control HbA_1c <7.9% n = 132	Poor glycemic control HbA_1c >8 n = 77	P
Special diet for diabetes			0.12
Yes	71 (65%)	38 (35%)	
No	20 (51%)	19 (49%)	
Use of glucometer:			0.01
$\geq$1 time per day	50 (54%)	42 (45%)	
all others	82 (70%)	35 (30%)	
Never heard of HbA_{1C} test	51 (62%)	31 (38%)	0.81
Yearly measure of HbA_{1C}			0.68
Never	89 (62%)	54 (38%)	
Once or more	43 (65%)	23 (35%)	
Yearly doctor visit	127 (64%)	72 (36%)	0.37
Hospitalization over night	37 (54%)	31 (46%)	0.07

Table 30 shows the results of logistic regression analysis predicting poor glycemic control in Mexican American elders with diabetes adjusted with other variables.

Analysis found that subjects with ≤7 years of education (OR: 5.24, CI: 1.58-17.31) and those who had the disease 11+ years (OR: 2.68, CI: 1.35-5.30) are more likely to exhibit poor glycemic control, after adjusting for other variables.

TABLE 30. LOGISTIC REGRESSION ANALYSIS PREDICTING POOR GLYCEMIC CONTROL IN MEXICAN AMERICAN ELDERS WITH DIABETES (N=201)

Characteristics	Risk of having poor glycemic control Odds ratio (95% Confidence interval)
Age (continuous)	0.92 (0.85-1.00)
Male	0.97 (0.50-1.88)
≤7 grade education	5.24 (1.58-17.31)
≥11 years of disease	2.68 (1.35-5.30)
Use of insulin	1.43 (0.65-3.17)
Daily glucometer use	1.65 (0.86-3.16)
Unable to measure HbA1c	1.44 (0.71-2.92)

SUMMARY AND CONCLUSIONS

The present study examined the association of sociodemographic and health factors on glycemic control in Mexican American elders with diabetes using a finger prick sample to test HbA_1c collected as a part of a population-based study. This study was done in a high risk population of Mexican American elders aged ≥75 years old.

Glycemic control was affected by low education level, number of years with the disease and by severity of disease. Our findings in Mexican American elders with diabetes were consistent with other studies of Hispanics using HbA_1c to test glycemic control. As in other studies, gender did not influence glycemic control in this study (188); also, it made no difference if subjects spoke Spanish or English (192). Both groups (good and poor glycemic control) have similar BMIs and levels of physical inactivity. Obesity and physical inactivity are well known risk factors for diabetes. In well controlled clinical trials, weight loss has been shown to significantly improve glycemic control (195-197). Physical inactivity has been shown to be higher among older people, non college graduates, and minorities (198).

We found that low education was significantly associated with poor glycemic control. The effects of socioeconomic and lifestyle variables on glycemic control may depend on health beliefs and compliance with medical care (199). One study using data from the Strong Heart Study of American Indians aged 45-74 years found no significant difference between median HbA_1c at baseline (8.4%) and at 5-years follow-up (8.5%). These data indicated that American Indians have poor glycemic control (199). However, compliance with lifestyle changes and short diabetes duration were independent predictors of good glycemic control in a multiethnic indigent urban population that included Hispanics (20). Although special diet for diabetes was not significant in our study, older subjects in the good control group followed a diet for diabetes.

We also found that glycemic control was affected by number of years with the disease. Duration of diabetes was related to worsening glycemic control, perhaps because insulin secretion declines and insulin resistance increases as the disease progresses (199).

We found differences in treatment received. There were more subjects using insulin in the poor control group than in the good control group. Data from the Strong

Heart Study of American Indians aged 45-74 years found subjects treated with insulin had significantly higher levels of HbA_1c compared with subjects treated with diet alone (199). This phenomenon has been observed in other studies (201-203) and may reflect the common clinical practice of placing patients who have poor control on more aggressive therapies.

In conclusion, low education level, disease duration, and severity of disease affect glycemic control in Mexican American elders. Our findings in this older Hispanic population will be useful in promoting education and developing lifestyle changes beginning in early adulthood to delay the onset of disease as a preventive measure in this high risk population.

CHAPTER 7: SUMMARY AND DISCUSSION

The purpose of this study was to describe the epidemiology of diabetes, diabetes complications and their consequences in Mexican American elders from the Hispanic Established Population Epidemiologic Study of the Elderly. The current burden of diabetes is greatest in the population >65 years of age (84, 151), and the largest percent increase in diagnosed diabetes are expected among those age >75 years (204).

Findings from the above publications of Mexican American elders with diabetes inform us that this population has high prevalence of diabetes, has high risk of developing complications, and is more affected with cardiovascular diseases (such as heart attack and stroke) that lead to early mortality, compared to Mexican American elders without diabetes. These findings are significant, because the uniqueness of this sample, its older age distribution, and the number of years it has been followed up.

FINDINGS OF THE CROSS-SECTIONAL ANALYSIS (BASELINE, 1993-1994)

The estimated prevalence of self-reported diabetes in Mexican American elders at baseline (ages 65+ in 1993-1994) was 22%. The prevalence of diabetes in Mexican American elders is higher than in the general population. Studies conducted over the past few decades (San Antonio Health Study, San Luis Valley Study, Starr County Study, the HHANES, and the Hispanic EPESE) have found that Mexican Americans have higher prevalence of diabetes than both non-Hispanic Whites and non-Hispanic Blacks. Data from the HHANES (1982-1984) reported that Mexican Americans aged 45-74 years had a higher prevalence of diabetes than Non-Hispanic Whites or Non-Hispanic Blacks in the same age group (92). Data from the Medicare fee-for-service beneficiaries for people

>65 years of age that included four racial/ethnic groups (Whites, Blacks, Hispanics, and Asians) in 2001 reported a significantly higher prevalence of diabetes among Hispanics than among Blacks, Asians, and Whites (151).

The estimated prevalence of diabetes complications in the Hispanic EPESE was 60% at baseline. Of those subjects with complications, 38% had retinopathy, 14% reported nephropathy, 40% had peripheral vascular disease, and 8% had amputations. Diabetic complications were associated with lower education, being unmarried, having the disease for 15 or more years and certain chronic conditions.

Having any complications (nephropathy, retinopathy, peripheral vascular disease, and amputations) was associated with low education as was also found in the San Antonio Heart Study (44) and the San Luis Valley Study (48). It also makes sense that having the disease for 20 or more years would be associated with complications such as retinopathy and peripheral vascular disease, which are highly duration-dependent. Such complications were seen also in the San Antonio Heart Study (65, 95, 99, 100, 152), the San Luis Valley Study (48, 110), and the Starr County Study (46, 108) .

Diabetic nephropathy refers to the presence of elevated urinary protein excretion in a person with diabetes in the absence of other renal disease (153). The primary constituent of urinary protein in diabetic nephropathy is albumin. Consequently, quantification of urinary albumin excretion is central to any description of diabetic renal disease (153). In the Hispanic EPESE, heart attack was found to be associated with nephropathy. However, being male and having health insurance are associated with lower risk of nephropathy. In the San Antonio Heart Study (42), 26% of Mexican Americans aged 25-64 years old were found not to have any type of health insurance and more commonly reported microvascular complications (nephropathy and retinopathy).

Previous studies have shown that microalbuminuria is associated with increased risk of death from cardiovascular disease (154), and diabetic nephropathy is associated with disease duration, hypertension, hyperglycemia, and smoking (153).

Diabetic retinopathy is the leading cause of new blindness in people age 20-74 years in the United States (155). It is characterized by alterations in the small blood vessels in the retina. An estimated 97% of insulin-taking and 80% of non-insulin-taking persons who have diabetes for >15 years have retinopathy (155). Retinopathy from the Hispanic EPESE was associated with low education, having the disease for 15 or more years and having a heart attack. One previous study reported that the prevalence of retinopathy was 48% in Mexican Americans and increased with increasing disease duration and increasing levels of HbA_1c (156).

Peripheral vascular disease (PVD) is clinically identified by intermittent claudication and/or absence of peripheral pulses in the lower legs and feet. These clinical manifestations reflect decreased arterial perfusion of the extremity (157). Peripheral vascular disease in the Hispanic EPESE was associated with low education, having the disease for 20 or more years, receipt of insulin or the combination of hypoglycemics and insulin, and having had a heart attack. PVD is associated with increasing age and duration of diabetes (157). Hypertension, smoking, and hyperlipidemia, which are frequently present in patients with diabetes, contribute additional risk for vascular disease (157). PVD in diabetes is compounded by the presence of peripheral neuropathy and by susceptibility to infection. These confounding factors in diabetic patients contribute to progression of PVD to foot ulcerations, gangrene, and ultimately amputations of part of the affected extremity (157).

Amputations are surgical procedures performed for multiple indications including gangrene, peripheral arterial occlusion, non-healing ulcers, severe soft tissue infections, osteomyelitis, trauma, tumors, and deformities (161). The prevalence of amputation in the Hispanic EPESE was associated with being male, having retinopathy, having hip fracture, and having the disease for 15 years or more. Leg amputation was the most common type of amputation followed by foot amputation. Amputation rates are greater with increasing age, greater in males, and greater among all racial/ethnic minorities compared with whites (161). Data from the 1983-90 National Hospital Discharge Surveys (NHDS) indicate that 6% of hospitalizations listing diabetes on the discharge record also listed a lower extremity ulcer condition (161).

Persons with diabetic complications are more likely to be impaired in their normal activities than are those without complications (103, 205). Impairment increases with age, duration of diabetes, fasting glucose, body mass index, insulin use, presence of hypertension, and presence of one or more vascular complications (206). Extended impairments in basic life activities signal a greater degree of dependency for the affected individual and an increased likelihood of institutionalization (205).

FINDINGS FROM THE FIVE-YEAR FOLLOW-UP ANALYSIS: AMPUTATIONS

The incidence of new amputations over five years in non-amputees at baseline was 12%. In the Hispanic EPESE, mortality among diabetic amputees was 46% during a 5-year follow-up.

Obesity, stroke, and 10 or more years with diabetes were significantly associated with new amputations during five-year follow-up. The most common type of amputation reported was leg amputation. Also, 40% of subjects with an amputation at baseline were found to have a second amputation at five-year follow-up. It is well documented that diabetes-related amputation rates increase sharply with age (204, 208). Although age appears to be a risk factor for amputations in diabetic individuals, it is often confounded with diabetes duration (208, 209). Duration of diabetes for more than 10 years was strongly associated with amputations in our sample. Other significant predictors of amputations were obesity, hip fracture, and stroke. Stroke has previously been found to be a significant risk factor for amputations in diabetic subjects (210, 211).

Reiber et al. predicted that 6-30% of amputees will undergo a second amputation within 1-3 years of their initial amputation (161). Our study found that 40% of subjects with an amputation at baseline due to diabetes had a second amputation at five-year follow-up. Some amputations never heal and subsequently become infected or gangrenous and require additional surgery (162). Gangrene is more common among diabetics and is a common cause of amputation (212). A second amputation may be attributed to progression of the disease and non-healing wounds (162). The patient who has an amputation of a leg because of diabetes not only has a higher risk of amputation of the second leg, but also has a higher mortality risk (213). Between 41% and 70% of persons with diabetes who experience a lower extremity amputation die within 5 years (208, 214), 30% require an amputation of the remaining limb within 3 years, and 51% in 5 years (214). We found the mortality rate in the Hispanic EPESE sample of diabetic patients without amputations was 28%, but mortality almost doubled (46%) in those persons with diabetes who experienced an amputation. Serious comorbid conditions are common in this population, and mortality in amputees is often attributed to cardiac or renal complications (165).

There are many potential explanations for high proportions of amputations in Mexican American elders. In general, Mexican Americans often have diabetes at an early age, and diabetes prevalence is 2 to 4 times higher than in non-Hispanic Whites (11, 44, 46, 48, 86, 87). They are also more likely to be obese (7, 48), to have related microvascular complications (7, 44), severe retinopathy (99), and to suffer from subsequent functional impairment (106). Being obese or blind are important issues in self-care for high risk patients. Patients who cannot reach and adequately visualize their feet cannot initiate self-care strategies or identify early warning signs of ulceration or infection (162). Additional social and cultural issues may also affect amputation morbidity. Mexican Americans are more likely to have lower educational levels (44, 215), to be poor, and to be uninsured (7, 52, 162). Language barriers, illiteracy, and acculturation-related factors may also be associated with less access to prevention or early intervention of this disease (162).

FINDINGS FROM THE SEVEN-YEAR FOLLOW-UP ANALYSIS: HEART ATTACK, STROKE, AND MORTALITY

The four leading causes of death in persons with diabetes are cardiovascular disease, diabetes, malignant neoplasms, and cerebrovascular disease (179). There is evidence that diabetes ranks higher as a cause of death in racial/ethnic minority populations than in Whites in the United States (179). Heart attack is the most commonly reported cause of death in diabetic Mexican American elders in this study. People with previous self-reported heart attack had a high risk of dying during the seven-year follow-up period. Heart attacks accounted for 45% of deaths among diabetic Mexican Americans with four complications, followed by cancer, stroke, and diabetic complications. Over 15% of patients with diabetes had a history of heart attack and 11% had a history of stroke in this study. The presence of both diabetes and stroke substantially increased the odds of reporting fair/poor self-rated health, and of dying within seven years. In addition, subjects with diabetic complications were significantly more likely to die than those without complications, particularly subjects with more than 2 self-reported complications at baseline.

Age was a significant predictor for incident heart attack at 7-year follow-up. Age was also reported in previous studies to be a major risk factor for heart attack (115, 116). The incidence of stroke also increases with increasing age. In the Hispanic EPESE, the incidence of stroke at 7-year follow–up was 4%. In addition, mortality of those with both diabetes and stroke at 7-year follow-up was 24%. The effects of diabetes and stroke on self-rated health and mortality were cumulative. Although the presence of other medical conditions also increased these risks, the effect of diabetes with presence of stroke was substantial, even after stratifying for other chronic conditions or adjusting for other conditions simultaneously in the models.

An interesting finding here was that some known risk factors for heart attack -- such as diabetes, hypertension and stroke -- were significantly associated with self-reported heart attack *at baseline*, as in other studies (14, 168-172). Incidence of heart disease in population-based studies in diabetic and non-diabetic White adults were studied in the Wisconsin Study (173), Rancho Bernardo Study (174), Nurses Health Study (175), and others which reported that the risk of fatal ischemic heart disease was significantly greater among those with diabetes than among those without.

Heart attack was the underlying cause of death for more than 40 percent of those who died during follow-up in the Hispanic EPESE study. However, other studies have reported low rates of mortality in Mexican American men (14, 62, 216-220), because subjects may have had some cardiovascular risk factors later in life and thus experienced lower cardiovascular mortality rates (62). It may seem paradoxical that Mexican Americans, at least Mexican American men, have lower cardiovascular disease mortality than non-Hispanic whites in view of their high rates of obesity, diabetes, and hypertension (14). This may be due to unknown protective factors, increased case fatality, or competing mortality (119). Goff et al. found that patients who died within 28-days of hospital admission were older, more likely to be Mexican American, to be female, and to be diabetic than non-fatal cases (221).

Mortality over five-years in subjects with both diabetes and stroke was two and a half-fold compared to those without these diseases. These results are consistent with other studies (176-178) including the Multiple Risk Factor Intervention Trial (MRFIT) that found 2.8-fold risk of mortality in subjects with diabetes and stroke (169). Persons with diabetes may have a worse prognosis after a stroke (123). One explanation is that many stroke patients may have undetected diabetes at the time of stroke; subsequent examination in the hospital or following treatment for stroke may identify the previously undetected diabetes (123).

Previous studies reported that the propensity of leanness was related to diabetes mortality (53), which was consistent with our results where more than half of subjects categorized as BMI of less than 22 died at 7-year follow-up. While obesity is often associated with diabetes in Mexican Americans (14), obesity alone does not explain the excess prevalence and incidence of diabetes (47). Older Mexican Americans who required insulin had higher mortality rates even after correction for age and duration of diabetes (53). Mexican Americans have been found to have worse glycemic control, even after adjustment for treatment status (222).

Mexican American elders with nephropathy were nearly twice as likely to die as subjects without diabetic complications. It is likely that the development of diabetic nephropathy is indicative of a generalized worsening that leads to higher mortality. Diabetic end-stage renal disease rates have been shown to be higher in Mexican Americans than in non-Hispanic Whites (111, 180, 181). Pugh (181) found that Mexican Americans had a risk ratio of 2.9 to 7 for end-stage renal disease compared with non-Hispanic Whites. In a cohort study of diabetic end-stage renal disease in Texas (223), 93% of Mexican Americans with end-stage renal disease had non-insulin-dependent diabetes mellitus.

As in the general population, mortality in persons with diabetes increases with age (179). One study examining mortality data from the Medicare fee-for-service beneficiaries of people >65 years of age included four racial/ethnic groups (White, Blacks, Hispanics, and Asians) in 2001 reported lower mortality rates among Hispanics and Asians with diabetes than among White and Black elders. These reports are consistent with lower mortality rates found among those without diabetes (154) and reports of all cause mortality reported by the National Center for Health Statistics (182), and the recent report of Bertoni et al. using Medicare data from 1995 to 1999 (183).

In conclusion, Mexican American elders with self-reported heart attack were more likely to be older, to be male, and to have a history of diabetes, hypertension and stroke. Mexican American elders with both diabetes and stroke have significantly higher rates of disabilities, poor self-rated health, and higher mortality than persons without these diseases, regardless of the presence of other conditions. The risk of 7-year mortality increased with the number of diabetic complications. Detection of and early treatment/control for diabetic complications may lead to increase survival in this population. Modifying or preventing risk factors through the promotion of healthy lifestyles could decrease diabetes morbidity and mortality.

FINDINGS FROM THE ELEVEN-YEAR FOLLOW-UP ANALYSIS OF THE COMBINED HBA$_1$C SUBSAMPLE

The present study examined the association of sociodemographic and health factors on glycemic control in Mexican American elders with diabetes using a finger prick sample to test HbA$_1$c collected as a part of a population-based study. This study was done in a high risk population of Mexican American elders aged 75 years old and over in 2004-2005 (n=209).

Glycemic control was affected by poor education level, number of years the subject had the disease and by disease severity. One positive finding was that more than 60% of screened diabetic subjects were in the good control group (HbA$_1$c mean = 6.8%) compared to the poor control group. Also, older subjects (>80 + years) were more likely to be in the good control group than were younger subjects (75-79 years).

Our findings in Mexican American elders with diabetes were consistent with other diabetes Hispanic studies using HbA$_1$c to test glycemic control. As in other studies, gender did not influence glycemic control in this study (188). Also, as in other studies, it made no difference if subjects spoke Spanish or English (192).

We found that low education was significantly associated with poor glycemic control. The effects of socioeconomic and lifestyle variables on glycemic control may depend on health beliefs and compliance with medical care (199). Both groups (good and poor glycemic control) have similar BMIs and are similarly physically inactive.

Obesity and physical inactivity are well known risk factors for diabetes. Physical inactivity has been show to be higher among older people, non college graduates, and minorities (198). Compliance with lifestyle changes and short diabetes duration were independent predictors of good glycemic control in a multiethnic indigent urban population that included Hispanics (200).

We also found that glycemic control was affected by number of years with the disease. Longer duration of diabetes was related to worse glycemic control. This may be because of declining insulin secretion and increasing insulin resistance as the disease progresses (199). Poor glycemic control in patients with diabetes has been linked to a greater incidence of many microvascular and macrovascular diabetic complications and an increased cost of health care for this population (132). A report from NHANES III (196) found that ethnic minorities (non-Hispanic Blacks and Mexican Americans) had poorer glycemic control than did non Hispanic Whites.

In Mexican American elders, we found more subjects using insulin in the poor control group than in the good control group. Data from the Strong Heart Study of American Indians aged 45-74 years found subjects treated with insulin had significantly higher levels of HbA_1c compared with subjects treated with diet alone (199). This phenomenon has been observed in several studies (201-203) and may reflect the common clinical practice of placing patients with poor control on more aggressive therapies.

Improved glycemic control is associated with long term health benefits such as decreased incidence of retinopathy, neuropathy, nephropathy, and other end-stage complications (133, 134). Even a 1% improvement in the HbA_1c value can result in a 10% reduction in the risk for coronary artery disease (224). The Diabetes Control and Complications Trial (DCCT), has demonstrated that persons with insulin-dependent diabetes mellitus with no retinopathy at baseline with intensive insulin treatment had a 60% risk reduction in progression of retinopathy compared with persons with conventional insulin treatment (155). Also, compliance with lifestyle changes and short diabetes duration were independent predictors of good glycemic control in a multiethnic indigent urban population that included Hispanics (200). Although, special diet for diabetes was not significant in our study; older subjects in the good control group followed a diet for diabetes.

In conclusion, poor education level, disease duration, and severity of disease affect glycemic control in Mexican American elders. Our findings in this older Hispanic population will be useful in promoting education and developing lifestyle changes beginning in early adulthood to delay the onset of disease as a preventive measure in this high risk population.

LIMITATIONS OF THE STUDY

The first limitation of this study was the use of self-reported data from older Mexican Americans with diabetes. We were unable to evaluate clinically nephropathy, retinopathy, peripheral vascular disease, or the presence of heart attack or stroke. Public health researchers are concerned about the validity of self-report information (225, 226). Several studies have examined the relationship between self-reported data and information in the medical records for persons with medical diagnosis of diabetes. These studies report good reliability for self-reported data on diabetes (227-232). In addition, self-reported history of diabetes and diabetes complications have been reported from other national population-based studies and provide useful information (155, 232). Table 31 lists a number of studies examining the reliability of self reported data for diabetes,

diabetes complications, heart attack, and stroke using comparisons to medical records. One study (232) using data from 3 West Coast states found fair agreement of history of diabetic retinopathy between ambulatory medical record and patient survey data. A study from the 1989 National Health Interview Survey (NHIS) found a high consistency in the survey data of self-reported rates of "trouble seeing" and "blindness" in a probability sample of United States adults with history of diabetes retinopathy (155). Self-reported heart attack studies (228, 230-232) and self-reported stroke studies (228, 230, 231) found a good agreement between self-report condition and medical record information. Self-reported information can be wrong for numerous reasons including a misunderstanding of the diagnosis presented, or forgetfulness of the individual reporting (228). Likewise, medical records are not necessarily an accurate source of information (233-235). Serious non-reporting or misreporting of diagnoses in medical charts has been found in several studies (234-236). For most important conditions such as diabetes, this is not probably not an issue, since self report is significantly correlated with medical record report (228).

TABLE 31. COMPARISON BETWEEN SELF-REPORTED MEDICAL CONDITIONS STUDIES AND AGREEMENT TO MEDICAL RECORDS

Year and ref.	Population and location	Sample size	Questionnaire items to determine diagnostic criteria	% Agreement between self-report condition and medical diagnosed condition
1985 (228)	>65 years old from Florida	120	Self-report physician diagnosed diabetes	98% 0.93 Kappa ∗
1990 (231)	>45 years old from Minnesota	2,037	Mailed survey of diabetes	97% 0.76 Kappa †

1994 (230)	40-64 years old men 35-64 years women From Germany	7,841	In person interview of diabetes	74% 0.84 Kappa †
1998 (232)	18-70 years old from CA, WA, and OR	1,270	Mailed survey of history of diabetes	92% 0.80 Kappa †
1999 (229)	18-64 years old Medicaid adults from Oregon	2,156	Telephone survey "Has a doctor ever told you that you have diabetes?"	96% 0.81 Kappa †
1998 (232)	18-70 years old from CA, WA, and OR	1,270	Mailed survey of history of diabetic retinopathy	79% 0.4 Kappa ‡
1985 (228)	>65 years old from Florida	120	Self-report physician diagnosed myocardial infarction	94% 0.70 Kappa †
1990 (231)	>45 years old from Minnesota	2,037	Mailed survey of myocardial infarction	97% 0.80 Kappa †
1994 (230)	40-64 years old men 35-64 years women From Germany	7,841	In person interview of myocardial infarction	71% 0.83 Kappa †
1998 (232)	18-70 years old from CA, WA, and OR	1,270	Mailed survey of history of myocardial infarction	93% 0.70 Kappa †
1985 (228)	>65 years old from Florida	120	Self-report physician diagnosed stroke	98% 0.85 Kappa †
1990 (231)	>45 years old from Minnesota	2,037	Mailed survey of stroke	97% 0.71 Kappa †
1994 (230)	40-64 years old men 35-64 years women From Germany	7,841	In person interview of stroke	62% 0.77 Kappa †

* Excellent agreement: Kappa >0.9
† Good agreement: Kappa <0.9 and >0.6
‡ Poor agreement: Kappa <0.6 and >0.3

A second limitation was the lack of information on past medical history, family history, or the sequence of occurrence regarding diabetes and diabetes complications and other diseases such as heart attack or stroke. Also, we were unable to review death certificates to find out other underlying or contributing causes of death in Mexican American elders with diabetes.

A third limitation was the inability to evaluate glucose level or glycemic control since baseline and incorporating an HbA_1c test only in the fifth wave of the study (2004-2005).

A fourth limitation was the potential bias inherent in using follow-up survivor subjects. Thus, our study sample may represent healthier subjects.

STRENGTHS OF THE STUDY

First, this is a large community-based study of 3050 Mexican Americans elders from five states which is generalizable to approximately 500,000 Mexican Americans aged 65 and older.

Second, the data contain several self-reported questions regarding diabetes and diabetes complications, including anthropometric measures.

Third, the data are prospective, allowing for assessment of diabetes and diabetes complications on heart attack, stroke, and mortality over time.

SUGGESTIONS FOR FUTURE RESEARCH

The findings from this dissertation will serve as a base for future studies of diabetes in Mexican American elders. Also, it will serve as a reference to study other Hispanic subgroups with diabetes. The Hispanic EPESE database is representative of over 500,000 Mexican American elders. In addition, we will know more about this Mexican American elder population if we incorporate blood samples to study biomarkers and genetics markers to explore why this Hispanic sub sample population is severely affected with this disease. Also, we could potentially study the link between obesity and Type 2 diabetes or aging and Type 2 diabetes. It will be interesting to explore the "Hispanic Paradox" comparing these healthy subjects with subjects from other ethnicities.

IMPLICATIONS

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 (237, 238). Objective 5-3 of the *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 (151).

Intervention in prevention and education need to focus on this older population to decrease the occurrence and lessen the severity of diabetes complications.

1. Mexican American elders with diabetes need regular clinical management to control the disease in order to prevent complications over time. Due to this population's low educational level, language barriers, and disconnect with medical care, Mexican American elders with diabetes need attention on this issue.

2. Mexican American elders with diabetes need to be involved in educational programs to self-monitor the disease, watch for disease progression and report abnormalities to their Primary Care Physician. Screening for complications such as

nephropathy, retinopathy, neuropathy, and peripheral vascular disease will be targeted in this population as a measure to prevent complications.

3. Mexican American elders have to learn about the benefits of healthy lifestyle changes. Lifestyle modification such as diet, exercise program, weight management, and increased physical activity will be very benefit to them.

4. Mexican American elders have to learn the adequate and timely use of their medication, insulin, and learn the appropriate control of their glycemia. Mexican American elders have to understand the importance of good glycemic control to avoid complications.

5. Mexican American elders have to be involved in educational programs of chronic disease management. In general, this population has more than one chronic disease. Patient self-management could profoundly impact their health status if Mexican American elders with diabetes learn self-management of heart disease, high blood pressure, arthritis, and lung disease.

BIBLIOGRAPHY

1. Olefsky JM. Prospects for research in diabetes mellitus. JAMA 2001;285:628-32.

2. Markides KS, Stroup-Benham C.A., Goodwin J.S. The Health of Mexican American Elderly: Selected findings from the Hispanic EPESE. In: Wykle ML, Ford AB, eds. Serving Minority Elders in the 21st Century. New York, NY: Springer Publishing Company, 1999:72-90.

3. Markides KS, Eschbach K. Aging, migration, and mortality: Current status of research on the Hispanic paradox. Journals of Gerontology Series B-Psychological Sciences and Social Sciences 2005;60:68-75.

4. He W, Sengupta M, Velkoff V, DeBarros KA. 65+ in the United States:2005. Washington, DC, U.S. Department of Health and Human Services. Current Population Reports. Special Studies. December 2005;P23-209.

5. U.S.Bureau of Census. Current Population Reports. The Hispanic Population in the United States: March 2002. P20-545.

6. Ramirez RR, De la Cruz P. The Hispanic Population in the United States: March 2002. Population Characteristics. Washington, D.C., U.S. Bureau of the Census. Current Population Reports. 2003;P20-545.

7. Stern MP, Mitchell BD. Diabetes in Hispanic Americans. In: National Institute of Diabetes and Digestive and Kidney Disease, ed. National Diabetes Data Group. Diabetes in America. Bethesda, MD: 1995:631-59.

8. Caudle P. Providing Culturally Sensitive Health Care to Hispanic Clients. Nurse Practitioner 1993;18:40-51.

9. Munoz E. Care for the Hispanic Poor - A Growing Segment of American-Society. Jama-Journal of the American Medical Association 1988;260:2711-2.

10. Hayes-Bautista D. Latino Health indicators and the underclass model: From Paradox to new Policy Models. In: Furino A, ed. Health Policy and the Hispanics. Boulder, CO: Westview Press, 1992:32-47.

11. Markides KS, Coreil J. The Health of Hispanics in the Southwestern United-States - An Epidemiologic Paradox. Public Health Reports 1986;101:253-65.

12. Sorlie PD, Backlund E, Johnson NJ, Rogot E . Mortality by Hispanic status in the United States. JAMA 1993;270:2464-8.

13. Hummer RA, Rogers RG, Amir SH, Forbes D, Frisbie WP. Adult mortality differentials among Hispanic subgroups and non-Hispanic whites. Social Science Quarterly 2000;81:459-76.

14. Diehl AK, Stern MP. Special Health problems of Mexican-Americans: obesity, gallbladder disease, diabetes mellitus, and cardiovascular disease. Adv Intern Med 1989;34:73-96.

15. Hazuda HP, Espino DV. Aging, Chronic Disease, and Physical Disability in Hispanic Elderly. In: Markides K, Miranda MR, eds. Minorities, Aging, and Health. London, UK: Sage Publications, 1997:127-48.

16. Markides K, Rudkin L, Angel RJ, Espino DV. Health Status of Hispanic elderly in the United States. In: Martin LG, Soldo BJ, eds. Racial and Ethnic differences in the Health of Older Americans. Washington, DC: National Academy Press, 1997.

17. Harris MI. Diabetes in America: Epidemiology and scope of the problem. Diabetes Care 1998;21:C11-C14.

18. CDC. National Diabetes Fact Sheet: United States, 2003. 2004. Atlanta, GA, U.S. Department of Health and Human Services.

19. American Diabetes Association. All about Diabetes. American Diabetes Association . 2007.

20. American Diabetes Association. Standards of Medical Care in Diabetes. Diabetes Care 2004;27:S15-S35.

21. Zimmet P, Alberti KGMM, Shaw J. Global and societal implications of the diabetes epidemic. Nature 2001;414:782-7.

22. van Tilburg J, van Haeften TW, Pearson P, Wijmenga C. Defining the genetic contribution of type 2 diabetes mellitus. Journal of Medical Genetics 2001;38:569-78.

23. Gloyn AL, McCarthy MI. The genetics of type 2 diabetes. Best Practice & Research Clinical Endocrinology & Metabolism 2001;15:293-308.

24. Ludwig-Beymer P, Huether SE, Gray DP. Alterations of Hormonal Regulation. In: McCance KL, Huether SE, eds. Pathophysiology: The Biology Basis for Disease in Adults and Children. St. Louis, Missouri: Mosby, 1994:674-92.

25. Zimmet P, Dowse G, Finch C, Serjeantson S, King H. The Epidemiology and Natural-History of NIDDM - Lessons from the South-Pacific. Diabetes-Metabolism Reviews 1990;6:91-124.

26. Chan JM, Rimm EB, Colditz GA, Stampfer MJ, Willett WC. Obesity, Fat Distribution, and Weight-Gain As Risk-Factors for Clinical Diabetes in Men. Diabetes Care 1994;17:961-9.

27. Mitchell BD, Williams-Blangero S, Chakraborty R, Valdez RA, Hazuda HP, Haffner SM, Stern MP. A comparison of three methods for assessing Amerindian Admixture in Mexican Americans. Ethnicity & Disease 1993;3:22-31.

28. Burchard EG, Borrell LN, Choudhry S, Naqvi M, Tsai HJ, Rodriguez-Santana JR, Chapela R, Rogers SD, Mei R, Rodriguez-Cintron W, Arena JF, Kittles R, Perez-Stable EJ, Ziv E, Risch N. Latino populations: A unique opportunity for the study of race, genetics, and social environment in epidemiological research. American Journal of Public Health 2005;95:2161-2168.

29. Stern MP, Gonzalez C, Mitchell BD, Villalpando E, Haffner SM, Hazuda HP. Genetic and Environmental Determinants of Type-II Diabetes in Mexico-City and San-Antonio. Diabetes 1992;41:484-492.

30. Chakraborty R. Gene admixture in Human Populations: models and predictions. Yearb Phys Anthropol 1986;29:1-43.

31. Stern MP, Haffner SM. Type-II Diabetes and Its Complications in Mexican-Americans. Diabetes-Metabolism Reviews 1990;6:29-45.

32. Hanis CL, Hewettemmett D, Bertin TK, Schull WJ. Origins of United-States Hispanics - Implications for Diabetes. Diabetes Care 1991;14:618-627.

33. Gardner LI, Stern MP, Haffner SM, Gaskill SP, Hazuda HP, Relethford JH, Eifler CW. Prevalence of Diabetes in Mexican-Americans - Relationship to Percent of Gene Pool Derived from Native-American Sources. Diabetes 1984;33:86-92.

34. Estrada AL, Trevino FM, Ray LA. Health-Care Utilization Barriers Among Mexican-Americans - Evidence from HHANES 1982-84. American Journal of Public Health 1990;80:27-31.

35. Trevino FM, Moyer M.E, Valdez R.B, StroupBenham C.A. Health-Insurance Coverage and Utilization of Health-Services by Mexican-Americans, Mainland Puerto-Ricans, and Cuban Americans. JAMA 1991;265:233-237.

36. Anderson R, Lewis SZ, Giachello AL, Aday LA, Chiu G. Access to medical care among the Hispanic population of the southwestern United States. Journal of Health and Social Behavior 1981;22:78-89.

37. Bruhn JG, Fuentes RG. Cultural Factors Affecting Utilization of Services by Mexican-Americans. Psychiatric Annals 1977;7:20-29.

38. Markides KS, Levin JS, Ray LA. Determinants of Physician Utilization Among Mexican-Americans - A 3-Generations Study. Medical Care 1985;23:236-46.

39. Quesada GM, Heller PL. Sociocultural barriers to medical care among Mexican Americans in Texas: A summary report of research conducted by the Southwest Medical Sociology ad hoc committee. Medical Care 1977;15:93-101.

40. Ramirez de Arellano AB. The Elderly. In: Carlos W.Molina and Marilyn Aguirre-Molina, ed. Latino Health in the US: A growing Challenge. Washington, DC: American Public Health Association, 1994:189-208.

41. Roberts RE, Lee ES. Medical-Care Use by Mexican-Americans - Evidence from the Human-Population Laboratory Studies. Medical Care 1980;18:266-281.

42. Pugh JA, Tuley MR, Hazuda HP, Stern MP. The Influence of Outpatient Insurance Coverage on the Microvascular Complications of Non-Insulin-Dependent Diabetes in Mexican American. Journal of Diabetes and Its Complications 1992;6:236-41.

43. Espino DV, Moreno CA, Talamantes M. Hispanic elders in Texas: Implications for Health Care. Texas Medicine 1993;89:58-61.

44. Haffner SM, Hazuda HP, Mitchell BD, Patterson JK, Stern MP. Increased Incidence of Type-II Diabetes-Mellitus in Mexican-Americans. Diabetes Care 1991;14:102-8.

45. Cowie CC, Engelgau MM, Rust KF, Saydah SH, Byrd-Holt DD, Williams DE, Eberhardt MS, Geiss LS, Flegal KM, Gregg EW. Prevalence of diabetes and impaired fasting glucose in adults in the US population - National Health and Nutrition Examination Survey 1999-2002. Diabetes Care 2006;29:1263-1268.

46. Hanis CL, Ferrell RE, Barton SA, Aguilar L, Garzaibarra A, Tulloch BR, Garcia CA, Schull WJ. Diabetes Among Mexican-Americans in Starr County, Texas. American Journal of Epidemiology 1983;118:659-72.

47. Monterrosa AE, Haffner SM, Stern MP, Hazuda HP. Sex Difference in Life-Style Factors Predictive of Diabetes in Mexican-Americans. Diabetes Care 1995;18:448-56.

48. Hamman RF, Marshall JA, Baxter J, Kahn LB, Mayer EJ, Orleans M, Murphy JR, Lezotte DC. Methods and Prevalence of Non-Insulin-Dependent Diabetes-Mellitus Ina Biethnic Colorado Population - the San-Luis-Valley Diabetes Study. American Journal of Epidemiology 1989;129:295-311.

49. Harris MI, Hadden WC, Knowler WC, Bennett PH. Prevalence of Diabetes and Impaired Glucose-Tolerance and Plasma-Glucose Levels in United-States Population Aged 20-74 Yr. Diabetes 1987;36:523-34.

50. Haffner SM, Hazuda HP, Mitchell BD, Patterson JK, Stern MP. Increased Incidence of Type-II Diabetes-Mellitus in Mexican-Americans. Diabetes Care 1991;14:102-8.

51. Black SA. Increased health burden associated with comorbid depression in older diabetic Mexican Americans - Results from the Hispanic established population for the Epidemiologic Study of the Elderly survey. Diabetes Care 1999;22:56-64.

52. Black SA, Jacobi PL, Rush RD, Di Nuzzo AR, Garcia D. Ethnic variation in the health burden of self-reported diabetes in adults aged 75 and older. Ethnicity & Disease 1999;9:22-31.

53. West KM. Epidemiology of Diabetes and its Vascular Lesions. New York, NY: Elsevier, 1978.

54. Hazuda HP, Haffner S.M, Stern MP, Eifler CW. Effects of Acculturation and Socioeconomic-Status on Obesity and Diabetes in Mexican-Americans - the San-Antonio Heart-Study. American Journal of Epidemiology 1988;128:1289-301.

55. Marshall JA, Hamman RF, Baxter J, Mayer EJ, Fulton DL, Orleans M, Rewers M, Jones RH. Ethnic-Differences in Risk-Factors Associated with the Prevalence of Non-Insulin-Dependent Diabetes-Mellitus - the San-Luis Valley Diabetes Study. American Journal of Epidemiology 1993;137:708-18.

56. Harris MI. Epidemiologic Correlates of NIDDM in Hispanics, Whites, and Blacks in the United-States Population. Diabetes Care 1991;14:639-48.

57. Marshall JA, Hamman RF, Baxter J. High-Fat, Low-Carbohydrate Diet and the Etiology of Non-Insulin-Dependent Diabetes-Mellitus - the San-Luis-Valley Diabetes Study. American Journal of Epidemiology 1991;134:590-603.

58. Marshall JA, Weiss NS, Hamman RF. The role of dietary fiber in the etiology of non-insulin dependent diabetes mellitus: The San Luis Valley Diabetes Study. Annals of Epidemiology 1993;3:18-26.

59. Kuczmarski RJ, Fregal KM, Campbell SM, Johnson CL. Increasing prevalence of overweight among US adults. JAMA 2004;272:205-11.

60. Ostir GV, Markides K, Freeman DH, Goodwin J.S. Obesity and Health Conditions in Elderly Mexican Americans: The Hispanic EPESE. Ethnicity & Disease 2000;10:31-8.

61. Yanovski JA, Yanovski SZ. Recent advances in Basic Obesity Research. JAMA 1999;282:1504-6.

62. Mitchell BD, Stern MP, Haffner SM, Hazuda HP, Patterson JK. Risk-Factors for Cardiovascular Mortality in Mexican-Americans and Non-Hispanic Whites - the San-Antonio Heart-Study. American Journal of Epidemiology 1990;131:423-33.

63. National Institute of Health. Third Report of the National Cholesterol Eduction Program Expert panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). NIH Publication 01-3670. 2002. Bethesda, MD, National Institute of Health.

64. Stern MP, Gaskill SP, Hazuda HP, Gardner LI, Haffner SM. Does Obesity Explain Excess Prevalence of Diabetes Among Mexican-Americans - Results of the San-Antonio Heart-Study. Diabetologia 1983;24:272-277.

65. Stern MP, Haffner SM. Type II diabetes in Mexican Americans: A public Health challenge. In: Furino A ed. Health Policy and the Hispanic. Boulder, CO: Westview Press, 1992:57-75.

66. Haffner SM, Stern MP, Hazuda HP, Pugh J, Patterson JK. Do Upper-Body and Centralized Adiposity Measure Different Aspects of Regional Body-Fat Distribution - Relationship to Non-Insulin-Dependent Diabetes-Mellitus, Lipids, and Lipoproteins. Diabetes 1987;36:43-51.

67. Joos SK, Mueller WH, Hanis CL, Schull WJ. Diabetes Alert Study - Weight History and Upper Body Obesity in Diabetic and Non-Diabetic Mexican-American Adults. Annals of Human Biology 1984;11:167-71.

68. Mueller WH, Joos SK, Hanis CL, Zavaleta AN, Eichner J, Schull WJ. The Diabetes Alert Study - Growth, Fatness, and Fat Patterning, Adolescence Through Adulthood in Mexican-Americans. American Journal of Physical Anthropology 1984;64:389-99.

69. Stern MP, Knapp JA, Hazuda HP, Haffner SM, Patterson JK, Mitchell BD. Genetic and Environmental Determinants of Type-II Diabetes in Mexican-Americans - Is There A Descending-Limb to the Modernization Diabetes Relationship. Diabetes Care 1991;14:649-54.

70. Tuomilehto J, Lindstrom J, Eriksson J.G, Valle TT, Hamalainen H, Ilanne-Parikka P, Keinanen-Kiukaanniemi S, Laakso M, Louheranta A, Rastas M, Salminen V, Uusitupa M, Aunola S, Cepaitis Z, Moltchanov V, Hakumaki M, Mannelin M, Martikkala V, Sundvall J. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. New England Journal of Medicine 2001;344:1343-50.

71. Morley JE. The Metabolic syndrome and aging. J Gerontology: Medical Sciences 2004;59A:139-42.

72. Scott CL. Diagnosis, prevention, and intervention for the metabolic syndrome. American Journal of Cardiology 2003;92:35I-42I.

73. Moller DE, Kaufman KD. Metabolic syndrome: A clinical and molecular perspective. Annual Review of Medicine 2005;56:45-62.

74. Ford ES, Giles WH, Dietz WH. Prevalence of the metabolic syndrome among US adults - Findings from the Third National Health and Nutrition Examination Survey. JAMA 2002;287:356-9.

75. King H, Aubert RE, Herman WH. Global burden of diabetes, 1995-2025 - Prevalence, numerical estimates, and projections. Diabetes Care 1998;21:1414-31.

76. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes - Estimates for the year 2000 and projections for 2030. Diabetes Care 2004;27:1047-1053.

77. American Diabetes Association. Total Prevalence of Diabetes & Pre-diabetes. 2006.

78. National Institute of Diabetes and Kidney Diseases. Diabetes Overview. National Institute of Health. Publication No. 04-3873. 2004.

79. American Diabetes Association. Economic cost of diabetes in the U.S. in 2002. Diabetes Care 2003;26:917-32.

80. Mokdad AH, Ford ES, Bowman BA, Nelson DE, Engelgau MM, Vinicor F, Marks J.S. Diabetes trends in the US: 1990-1998. Diabetes Care 2000;23:1278-83.

81. Kenny SJ, Aubert RE, Geiss LS. Prevalence and Incidence of Non-Insulin-Dependent Diabetes. In: National Diabetes Data Group, ed. Diabetes in America. Washington, DC: NIH, 1995:47-67.

82. National Center for Health Statistics. Plan and Operation of the Hispanic Health and Nutrition Examination Survey 1982-84. Vital and Health Statistics Series 1, No. 19. PHS 85-1321. 1985. Washington, DC, U.S. Government Printing Office.

83. Perez Stable EJ, Mcmillen MM, Harris MI, Juarez RZ, Knowler WC, Stern MP, Haynes SG. Self-Reported Diabetes in Mexican-Americans - HANES 1982-84. American Journal of Public Health 1989;79:770-2.

84. Harris MI. Epidemiology of diabetes mellitus among the elderly in the United States. Clinical Geriatric Medicine 1990;6:703-19.

85. Baxter J, Hamman R.F, Lopez TK, Marshall JA; Hoag S; Swenson CJ . Excess incidence of known non-insulin-dependent diabetes mellitus (NIDDM) in Hispanics compared with Non-Hispanics Whites in the San Luis Valley, Colorado. Ethnicity & Disease 1993;3:11-21.

86. Espino DV, Parra EO, Kriehbiel R. Mortality Differences Between Elderly Mexican-Americans and Non-Hispanic Whites in San-Antonio, Texas. Journal of the American Geriatrics Society 1994;42:604-8.

87. Stern MP, Rosenthal M, Haffner SM, Hazuda HP, Franco LJ. Sex Difference in the Effects of Sociocultural Status on Diabetes and Cardiovascular Risk-Factors in Mexican-Americans - the San-Antonio Heart-Study. American Journal of Epidemiology 1984;120:834-851.

88. Bastida E, Cuellar I, Villas P. Prevalence of Diabetes Mellitus and related conditions in a South Texas Mexican American Sample. Journal of Community Health Nursing 2001;18:75-84.

89. Brown SA, Harrist RB, Villagomez ET, Segura M, Barton SA, Hanis CL. Gender and treatment differences in knowledge, health beliefs, and metabolic control in Mexican Americans with type B diabetes. Diabetes Educator 2000;26:425-38.

90. Hamman RF, Mayer EJ, Mooyoung GA, Hildebrandt W, Marshall JA, Baxter J. Prevalence and Risk-Factors of Diabetic-Retinopathy in Non-Hispanic Whites and Hispanics with NIDDM - San-Luis Valley Diabetes Study. Diabetes 1989;38:1231-7.

91. Mitchell BD, Stern MP. Recent Developments in the Epidemiology of Diabetes in the Americas. World Health Statistics Quarterly 1992;45:347-9.

92. Flegal KM, Ezzati TM, Harris MI, Haynes SG, Juarez RZ, Knowler WC, Perez-Stable EJ, Stern MP. Prevalence of Diabetes in Mexican-Americans, Cubans, and Puerto-Ricans from the Hispanic Health and Nutrition Examination Survey, 1982-1984. Diabetes Care 1991;14:628-38.

93. Delgado JL, Johnson CL, Roy I, Treviño F. Hispanic Health and Nutrition Examination Survey: Methodological Considerations. American Journal of Public Health 1990;80:6-10.

94. Espino DV, Burge SK, Moreno CA. The Prevalence of Selected Chronic Diseases among the Mexican American Elderly: Data from the 1982-1984 Hispanic Health and Nutrition Examination Survey. Journal American Board Family Practice 1991; 4:217-22.

95. Haffner SM, Mitchell BD, Stern MP, Hazuda HP. Macrovascular Complications in Mexican-Americans with Type-II Diabetes. Diabetes Care 1991;14:665-71.

96. Stern MP. The effect of glycemic control on the incidence of macrovascular complications of type 2 diabetes. Archives of Family Medicine 1998;7:155-62.

97. Burke JP, Williams K, Gaskill SP, Hazuda HP, Haffner SM, Stern MP. Rapid rise in the incidence of type 2 diabetes from 1987 to 1996 - Results from the San Antonio Heart Study. Archives of Internal Medicine 1999;159:1450-1456.

98. Harris MI, Eastman RC. Early detection of undiagnosed non-insulin-dependent diabetes mellitus. JAMA 1996;276:1261-2.

99. Haffner SM, Fong D, Stern M.P, Pugh JA, Hazuda HP, Patterson JK, Vanheuven WAJ, Klein R. Diabetic-Retinopathy in Mexican-Americans and Non-Hispanic Whites. Diabetes 1988;37:878-84.

100. Haffner SM, Mitchell B, Pugh JA, Stern MP, Kozlowski MK, Hazuda HP, Patterson JK, Klein R. Proteinuria in Mexican-Americans and Non-Hispanic Whites with Niddm. Diabetes Care 1989;12:530-6.

101. Haan MN, Weldon M. The influence of diabetes, hypertension, and stroke on ethnic differences in physical and cognitive functioning in an ethnically diverse older population. Annals of Epidemiology 1996;6:392-8.

102. Haffner SM, Hazuda HP, Mitchell BD, Patterson JK, Stern MP. Increased Incidence of Type-II Diabetes-Mellitus in Mexican-Americans. Diabetes Care 1991;14:102-8.

103. Otiniano ME, Black SA, Ray LA, Du XL, Markides KS. Correlates of Diabetic Complications in Mexican-American Elders. Ethnicity & Disease 2002;12:252-8.

104. Otiniano ME, Du XL, Ottenbacher K, Black SA, Markides KS. Lower extremity amputations in diabetic Mexican American elders - Incidence, prevalence and correlates. Journal of Diabetes and Its Complications 2003;17:59-65.

105. Otiniano ME, Ottenbacher KJ, Markides KS, Ray LA, Du XL. Self-reported heart attack in Mexican-American elders: Examination of incidence, prevalence, and 7-year mortality. Journal of the American Geriatrics Society 2003;51:923-9.

106. Macheledt JE, Vernon SW. Diabetes and disability among Mexican Americans: The effect of different measures of diabetes on its association with disability. Clinical Epidemiology 1992;45:519-28.

107. Otiniano ME, Du XL, Ottenbacher K, Markides KS. The effect of diabetes combined with stroke on disability, self-rated health, and mortality in older Mexican Americans: Results from the Hispanic EPESE. Archives of Physical Medicine and Rehabilitation 2003;84:725-30.

108. Hanis CL, Chu HH, Lawson K, Hewettemmett D, Barton SA, Schull WJ, Garcia CA. Mortality of Mexican-Americans with NIDDM - Retinopathy and Other Predictors in Starr County, Texas. Diabetes Care 1993;16:82-9.

109. Otiniano ME, Markides KS, Ottenbacher K, Ray LA, Du XL. Self-reported diabetic complications and 7-year mortality in Mexican American elders -

Findings from a community-based study of five Southwestern states. Journal of Diabetes and Its Complications 2003;17:243-8.

110. Hamman RF, Franklin GA, Mayer EJ, Marshall SM, Marshall JA, Baxter J, Kahn LB. Microvascular Complications of NIDDM in Hispanics and Non-Hispanic Whites - San Luis Valley Diabetes Study. Diabetes Care 1991;14:655-664.

111. Pugh JA, Stern MP, Haffner SM, Eifler CW, Zapata M. Excess Incidence of Treatment of End-Stage Renal-Disease in Mexican-Americans. American Journal of Epidemiology 1988;127:135-144.

112. Harris MI, Klein R, Cowie CC, Rowland M, Byrd-Holt DD. Is the risk of diabetic retinopathy greater in non-Hispanic blacks and Mexican Americans than in non-Hispanic whites with type 2 diabetes? A US population study. Diabetes Care 1998;21:1230-1235.

113. Mickelson JK, Blum CM, Geraci JM. Acute myocardial infarction. Clinical characteristics, management, and outcome in a metropolitan Veterans Affairs medical center teaching hospital. Journal American College Cardiology 1995; 29:429-48.

114. Sundquist J, Winkleby MA, Pudaric S. Cardiovascular disease risk factors among older black, Mexican-American, and white women and men: An analysis of NHANES III, 1988-1994. Journal of the American Geriatrics Society 2001;49:109-16.

115. Wingard DL, Barret-Connor E. Heart disease and diabetes, in National Diabetes Data Group. National Institute of Health, National Institute of Diabetes and Digestive and Kidney Disease. NIH Publication No. 95-1468, 429-448. 1995.

116. Goff DC, Nichaman MZ, Chan WY, Ramsey DJ, Labarthe DR, Ortiz C. Greater incidence of hospitalized myocardial infarction among Mexican Americans than non-Hispanic whites - The Corpus Christi Heart Project, 1988-1992. Circulation 1997;95:1433-40.

117. Mitchell BD, Hazuda HP, Haffner SM, Patterson JK, Stern MP. High prevalence of angina pectoris in Mexican-American men. A population with reduced risk of myocardial infarction. Annals of Epidemiology 1991;1:415-26.

118. Stern MP, Wei M. Do Mexican Americans Really Have Low Rates of Cardiovascular Disease? Preventive Medicine 1999;29:S90-S95.

119. Rewers M, Shetterly SM, Baxter J, Marshall JA, Hamman RF. Prevalence of Coronary Heart-Disease in Subjects with Normal and Impaired Glucose-Tolerance and Non-Insulin-Dependent Diabetes-Mellitus in A Biethnic Colorado Population - the San-Luis-Valley Diabetes Study. American Journal of Epidemiology 1992;135:1321-30.

120. Gillium RF. Epidemiology of Stroke in Hispanic Americans. Stroke 1995;26: 1707-1712.

121. Sahyoun NR, Lentzner H, Hoyert D, Robinson KN. Trends in Causes of death among the elderly. Centers for Disease Control and prevention and National Center for Health Statistics. 2001.

122. Bell DSH. Stroke in the Diabetic Patient. Diabetes Care 1994;17:213-9.

123. Kuller LH. Stroke and Diabetes. In: National Diabetes Data Group. Diabetes in America. 2nd. ed. National Institute of Diabetes and Digestive and Kidney Diseases. NIH Publication No.95-1468, 449-456. 1995. Bethesda.

124. Worley KL, Lalonde DR, Kerr DR, Benavente O, Hart RG. Survey of the causes of stroke among Mexican Americans in South Texas. Texas Medicine 1998;94: 62-67.

125. Wolf PA, Dagostino R.B, Belanger A.J, Kannel W.B. Probability of Stroke - A Risk Profile from the Framingham-Study. Stroke 1991;22:312-8.

126. Ontiveros J, Miller TQ, Markides KS, Espino DV. Physical and psychosocial consequences of stroke in elderly Mexican Americans. Ethnicity & Disease1999; 9:212-217.

127. Carter JS, Pugh JA, Monterrosa A. Non-insulin-dependent diabetes mellitus in minorities in the United States. Annals of Internal Medicine 1996;125:221-32.

128. Nathan DM. Initial management of glycemia in type 2 diabetes mellitus. New England Journal of Medicine 2002;347:1342-9.

129. American Diabetes Association. Standard of Medical Care in Diabetes. Diabetes Care 2004;27:S15-S35.

130. Diehl AK, Bauer RL, Sugarek NJ. Correlates of Medication Compliance in Non-Insulin-Dependent Diabetes-Mellitus. Southern Medical Journal 1987;80:332-5.

131. Kuo YF, Raji MA, Markides KS, Ray LA, Espino DV, Goodwin JS. Inconsistent use of diabetes medications, diabetes complications, and mortality in older Mexican Americans over a 7-year period - Data from the Hispanic established population for the epidemiologic study of the elderly. Diabetes Care 2003; 26:3054-60.

132. The Diabetes Control and Complications Trial Research Group. The effect of Intensive treatment of diabetes on the development and progression of long term complications in insulin-dependent diabetes mellitus. New England Journal of Medicine 1993;329:977-86.

133. U.K. Prospective Diabetes Study Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes. Lancet 1998;352:837-53.

134. Diabetes Control and Complications Trial Research Group. The effect of Intensive Treatment of diabetes on the development and progression of long term complications in insulin-dependent diabetes mellitus. New England Journal of Medicine 1993;329:977-86.

135. CDC Diabetes Cost-effectiveness Group. Cost-effectiveness of intensive Glycemic control, intensified Hypertension control, and serum Cholesterol level reduction for type 2 diabetes. JAMA 2002;287:2542-2551.

136. Grover SA, Coupal L, Zowall H, Alexander CM, Weiss TW, Gomes DRJ. How cost-effective is the treatment of dyslipidemia in patients with diabetes but without cardiovascular disease? Diabetes Care 2001;24:45-50.

137. Lewis EJ, Hunsicker LG, Bain RP, Rohde RD. The Effect of Angiotensin-Converting Enzyme-Inhibition on Diabetic Nephropathy. New England Journal of Medicine 1993;329:1456-62.

138. Brown SA, Kouzekanani K, Garcia AA, Hanis CL. Culturally competent diabetes self-management education for Mexican Americans - The Starr County Border Health Initiative. Diabetes Care 2002;25:259-68.

139. Diabetes Prevention Program Research Group. Reduction in the Incidence of type 2 diabetes with lifestyle intervention or metformin. New England Journal of Medicine 2002;346:393-403.

140. National Diabetes Advisory Board. The Prevention and Treatment of Five complications of Diabetes. HHS 83-8392. 1983. U.S. Department of Health and Human Services.

141. Bray GA. Overweight Is Risking Fate - Definition, Classification, Prevalence, and Risks. Annals of the New York Academy of Sciences 1987;499:14-28.

142. Katz S, Ford AB, Moskowitz RW. Studies of illness in the aged: The index of ADL, a standardized measure of biological and psychosocial function. JAMA 1963;185:914-919.

143. Rosow I, Breslau N. Guttman. Health scale for the aged. J Gerontology 1966;21:556-959.

144. Radloff LS. The CES-D Scale: a selft reported depression scale for research in the general population. Journal of Applied Psychological Measures 1977;1:385-401.

145. Blazer D, Hughes DC, George LK. The Epidemiology of Depression in An Elderly Community Population. Gerontologist 1987;27:281-287.

146. Schulberg HC, Mcclelland M, Burns BJ. Depression and Physical Illness - the Prevalence, Causation, and Diagnosis of Co-Morbidity. Clinical Psychology Review 1987;7:145-167.

147. Boyd JH, Weissman MM, Thompson WD, Myers JK. Screening for Depression in a Community Sample - Understanding the Discrepancies Between Depression Symptom and Diagnostic Scales. Archives of General Psychiatry 1982;39:1195-200.

148. SAS Institute Inc. SAS/STAT Software: Changes and Enhacements. Cary, NC: 1996.

149. SAS Institute Inc. SAS/STAT 9.1 User's Guide. Cary, NC: 2004.

150. Shah BV, Barnwell BG, Bieler GS. SUDAAN User's Manual Release 7.5. Triangle Park, NC: 1997.

151. Mcbean AM, Li SL, Gilbertson DT, Collins AJ. Differences in diabetes prevalence, incidence, and mortality among the elderly of four racial/ethnic groups: Whites, blacks, Hispanics, and Asians. Diabetes Care 2004;27:2317-2324.

152. Haffner SM, Hazuda HP, Stern MP, Patterson JK, Vanheuven WAJ, Fong D. Effect of Socioeconomic-Status on Hyperglycemia and Retinopathy Levels in Mexican-Americans with NIDDM Diabetes Care 1989;12:128-134.

153. Nelson GD, Knowler WC, Pettitt DJ, Bennett P. Kidney Disease in Diabetes. In: National Diabetes Data Group, ed. Diabetes in America. Washington, DC: NIH, 1995:349-400.

154. Messent JWC, Elliott TG, Hill RD, Jarrett R.J, Keen H, Viberti G. Prognostic-Significance of Microalbuminuria in Insulin-Dependent Diabetes-Mellitus - A 23-Year Follow-Up-Study. Kidney International 1992;41:836-839.

155. Klein R, Klein BEK. Vision Disorders in Diabetes. In: National Diabetes Data Group, ed. Diabetes in America. Washington, DC: NIH, 1995:293-338.

156. West SK, Klein R, Rodriguez J, Munoz B, Broman AT, Sanchez R, Snyder R. Diabetes and diabetic retinopathy in a Mexican American population - Proyecto VER. Diabetes Care 2001;24:1204-1209.

157. Palumbo PJ, Melton LJ. Peripheral Vascular Disease and Diabetes. In: National Diabetes Data Group, ed. Diabetes in America. Washington, DC: NIH, 1995:401-408.

158. Orchard TJ, Strandness DE. Assessment of Peripheral Vascular-Disease in Diabetes - Report and Recommendations of An International Workshop Sponsored by the American-Diabetes-Association and the American-Heart-Association September 18-20, 1992 New-Orleans, Louisiana. Circulation 1993;88:819-828.

159. Osmundson PJ, Chesebro J.H, Ofallon WM, Zimmerman BR, Kazmier FJ, Palumbo PJ. A Prospective-Study of Peripheral Occlusive Arterial-Disease in Diabetes .2. Vascular Laboratory Assessment. Mayo Clinic Proceedings 1981;56:223-232.

160. Palumbo PJ, Ofallon W.M, Osmundson PJ, Zimmerman BR, Langworthy AL, Kazmier FJ. Progression of Peripheral Occlusive Arterial-Disease in Diabetes-Mellitus - What Factors Are Predictive. Archives of Internal Medicine 1991;151:717-721.

161. Reiber GE, Boyko EJ, Smith DG. Lower Extremity foot ulcers and amputations in diabetes. In: National Institute of Diabetes and Digestive and Kidney Disease, ed. National Diabetes Data Group. Diabetes in America. Bethesda, MD: 1995:409-428.

162. Lavery LA, van Houtum W.H, Ashry HR, Armstrong DG, Pugh JA. Diabetes-related lower-extremity amputations disproportionately affect blacks and Mexican Americans. Southern Medical Journal 1999;92:593-599.

163. Wilson PWF, Anderson KM, Kannel WB. Epidemiology of Diabetes-Mellitus in the Elderly - the Framingham-Study. American Journal of Medicine 1986;80:3-9.

164. Centers for Medicare and Medicaid. http://cms.hhs.gov/mcbs/publdt.asp.

165. Lee JS, Lu M, Lee VS, Russell D, Bahr C, Lee ET. Lower-Extremity Amputation - Incidence, Risk-Factors, and Mortality in the Oklahoma Indian Diabetes Study. Diabetes 1993;42:876-882.

166. Allison PD. Survival Analysis using the SAS system: a practical guide. Cary, NC: 1995.

167. Wingard DL, Barret-Connor E. Heart Disease and Diabetes. In: NIH NIDDK, ed. Washington, DC: 1995:429-448.

168. Lindeman RD, Baumgartner RN, Romero LJ, Koehler KM, Hundley R, Schade DS, Allen AS, Garry PJ, Liang HC. Prevalences of type 2 diabetes, the insulin resistance syndrome, and coronary heart disease in an elderly, biethnic population. Diabetes Care 1998;21:959-966.

169. Stamler J, Vaccaro O, Neaton JD, Wentworth D. Diabetes, Other Risk-Factors, and 12-Yr Cardiovascular Mortality for Men Screened in the Multiple Risk Factor Intervention Trial. Diabetes Care 1993;16:434-444.

170. Stern MP, Gaskill SP, Allen CR, Garza V, Gonzales JL, Waldrop RH. Cardiovascular Risk-Factors in Mexican-Americans in Laredo, Texas. Prevalence of Overweight and Diabetes and Distributions of Serum-Lipids. American Journal of Epidemiology 1981;113:546-555.

171. Stern MP, Gaskill SP, Allen CR, Garza V, Gonzales JL, Waldrop RH. Cardiovascular Risk-Factors in Mexican-Americans in Laredo, Texas. Prevalence and Control of Hypertension. American Journal of Epidemiology 1981;113:556-562.

172. Stroup-Benham CA, Markides KS, Espino DV, Goodwin JS. Changes in blood pressure and risk factors for cardiovascular disease among older Mexican-Americans from 1982-1984 to 1993-1994. Journal of the American Geriatrics Society 1999;47:804-810.

173. Moss SE, Klein R, Klein BEK. Cause-Specific Mortality in A Population-Based Study of Diabetes. American Journal of Public Health 1991;81:1158-1162.

174. Barrettconnor EL, Cohn BA, Wingard DL, Edelstein SL. Why Is Diabetes-Mellitus A Stronger Risk Factor for Fatal Ischemic-Heart-Disease in Women Than in Men - the Rancho-Bernardo Study. JAMA1991;265:627-631.

175. Manson JE, Colditz GA, Stampfer MJ, Willett WC, Krolewski AS, Rosner B, Arky RA, Speizer FE, Hennekens CH. A Prospective-Study of Maturity-Onset Diabetes-Mellitus and Risk of Coronary Heart-Disease and Stroke in Women. Archives of Internal Medicine 1991;151:1141-1147.

176. Kattapong VJ, Becker TM. Ethnic differences in mortality from cerebrovascular disease among New Mexico's Hispanics, Native Americans and Non-Hispanic Whites, 1958 through 1987. Ethnicity & Disease 1993;3:75-82.

177. Sacco RL, Hauser WA, Mohr JP, Foulkes MA. One-Year Outcome After Cerebral Infarction in Whites, Blacks, and Hispanics. Stroke 1991;22:305-311.

178. Sacco RL, Hauser WA, Mohr JP. Hospitalized Stroke in Blacks and Hispanics in Northern Manhattan. Stroke 1991;22:1491-1496.

179. Geiss LS, Herman W, Smith PJ. Mortality in Non-Insulin Dependent Diabetes. In: National Diabetes Data Group, ed. Diabetes in America. Washington, DC: NIH, 1995:233-257.

180. Karter AJ, Ferrara A, Liu JY, Moffet HH, Ackerson LM, Selby JV. Ethnic disparities in diabetic complications in an insured population. JAMA 2002;287:2519-2527.

181. Pugh JA. Diabetic nephropathy and end-stage renal disease in Mexican Americans. Blood Purification 1996;14:286-92.

182. Anderson RN, Smith BL. Deaths: Leading Causes for 2001. National Center for Health Statistics. 9. 2003. Hyattsville, MD, National Vital Statistics.

183. Bertoni AG, Kirk JK, Goff DC, Wagenknecht LE. Excess mortality related to diabetes mellitus in elderly medicare beneficiaries. Annals of Epidemiology 2004;14:362-367.

184. Nathan DM, Singer DE, Hurxthal K, Goodson JD. The Clinical Information Value of the Glycosylated Hemoglobin Assay. New England Journal of Medicine 1984;310:341-346.

185. Singer DE, Coley CM, Samet JH, Nathan DM. Tests of Glycemia in Diabetes-Mellitus - Their Use in Establishing A Diagnosis and in Treatment. Annals of Internal Medicine 1989;110:125-137.

186. Sacks DB, Bruns DE, Goldstein DE, Maclaren NK, McDonald JM, Parrott M. Guidelines and recommendations for laboratory analysis in the diagnosis and management of diabetes mellitus. Diabetes Care 2002;25:750-786.

187. Goldstein DE, Little RR, Wiedmeyer HM, England JD, Rohlfing CL, Wilke AL. Is Glycohemoglobin Testing Useful in Diabetes-Mellitus - Lessons from the Diabetes Control and Complications Trial. Clinical Chemistry 1994;40:1637-40.

188. Ferrell RE, Hanis CL, Aguilar L, Tulloch B, Garcia C, Schull WJ. Glycosylated Hemoglobin Determination from Capillary Blood-Samples - Utility in An Epidemiologic Survey of Diabetes. American Journal of Epidemiology 1984;119:159-166.

189. American Diabetes Association. Test for Glycemia in Diabetes. Diabetes Care 2004;27:S91-S93.

190. American Diabetes Association. Screening for Diabetes. Diabetes Care 2002;25:S21-S24.

191. Harris MI, Eastman RC, Cowie CC, Flegal KM, Eberhardt MS. Racial and ethnic differences in glycemic control of adults with type 2 diabetes. Diabetes Care 1999;22:403-408.

192. Lasater LM, Davidson AJ, Steiner JF, Mehler PS. Glycemic control in English- vs Spanish-speaking Hispanic patients with type 2 diabetes mellitus. Archives of Internal Medicine 2001;161:77-82.

193. Tucker KL, Bermudez OI, Castaneda C. Type 2 diabetes is prevalent and poorly controlled among Hispanic elders of Caribbean origin. American Journal of Public Health 2000;90:1288-93.

194. Harris MI. Racial and ethnic differences in health insurance coverage for adults with diabetes. Diabetes Care 1999;22:1679-82.

195. AgursCollins TD, Kumanyika SK, TenHave TR, Adams Campbell LL. A randomized controlled trial of weight reduction and exercise for diabetes management in older African-American subjects. Diabetes Care 1997;20:1503-1511.

196. Heath GW, Wilson RH, Smith J, Leonard BE. Community-Based Exercise and Weight Control - Diabetes Risk Reduction and Glycemic Control in Zuni Indians. American Journal of Clinical Nutrition 1991;53:S1642-S1646.

197. Lehmann R, Kaplan V, Bingisser R, Bloch KE, Spinas GA. Impact of physical activity on cardiovascular risk factors in IDDM. Diabetes Care 1997;20:1603-1611.

198. Manson JE, Rimm EB, Stampfer MJ, Colditz GA, Willett WC, Krolewski AS, Rosner B, Hennekens CH, Speizer FE. Physical-Activity and Incidence of Non-Insulin-Dependent Diabetes-Mellitus in Women. Lancet 1991;338:774-8.

199. Hu DS, Henderson JA, Welty TK, Lee ET, Jablonski KA, Magee MF, Robbins DC, Howard BV. Glycemic control in diabetic American Indians - Longitudinal data from the Strong Heart Study. Diabetes Care 1999;22:1802-7.

200. Maldonado M, D'Amico S, Otiniano ME, Balasubramanyam A, Rodriguez L, Cuevas E. Predictors of glycaemic control in indigent patients presenting with diabetic ketoacidosis. Diabetes Obesity & Metabolism 2005;7:282-289.

201. Blaum CS, Hiss RG, Velez L, Halter JB. Characteristics related to poor glycemic control in NIDDM patients in community practice. Diabetes Care 1997;20:7-11.

202. Gill GV, Hardy KJ, Patrick AW, Masterson A. Random Blood-Glucose Estimation in Type-2 Diabetes - Does It Reflect Overall Glycemic Control. Diabetic Medicine 1994;11:705-8.

203. Oconnor PJ, Fragneto R, Coulehan J, Crabtree BF. Metabolic Control in Non-Insulin-Dependent Diabetes-Mellitus - Factors Associated with Patient Outcomes. Diabetes Care 1987;10:697-701.

204. Boyle JP, Honeycutt AA, Narayan KMV, Hoerger TJ, Geiss LS, Chen H, Thompson TJ. Projection of diabetes burden through 2050 - Impact of changing demography and disease prevalence in the US. Diabetes Care 2001;24:1936-40.

205. Songer TJ. Disability in Diabetes. In: National Institute of Diabetes and Digestive and Kidney Diseases, ed. National Diabetes Data Group. Diabetes in America. Bethesda: 1995:259-82.

206. Mitchell BD, Stern MP, Haffner SM, Hazuda HP, Patterson JK. Functional Impairment in Mexican-Americans and Non-Hispanic Whites with Diabetes. Journal of Clinical Epidemiology 1990;43:319-27.

207. Most RS, Sinnock P. The Epidemiology of Lower-Extremity Amputations in Diabetic Individuals. Diabetes Care 1983;6:87-91.

208. Nelson RG, Gohdes DM, Everhart JE, Hartner JA, Zwemer FL, Pettitt DJ, Knowler WC. Lower-Extremity Amputations in NIDDM - 12-Yr Follow-Up-Study in Pima-Indians. Diabetes Care 1988;11:8-16.

209. Moss SE, Klein R, Klein BEK. The Prevalence and Incidence of Lower-Extremity Amputation in A Diabetic Population. Archives of Internal Medicine 1992;152:610-616.

210. Larsson J, Agardh CD, Apelqvist J, Stenstrom A. Clinical characteristics in relation to final amputation level in diabetic patients with foot ulcers: a prospective study of healing below or above the ankle in 187 patients. Foot and Ankle International 1995;16:69-74.

211. van Houtum WH, Lavery LA, Armstrong DG. Risk factors for above-knee amputations in diabetes mellitus. Southern Medical Journal 1998;91:643-8.

212. Levin M.E. The Diabetic Foot: pathophysiology, evaluation and treatment. In: Levin ME, O'Neal LW, eds. The Diabetic Foot. St Louis: C.V. Mosby, 1988:1-50.

213. Shuman CR, Podolsky S. Surgery in the diabetic patient. In: Podolosky S, ed. Clinical Diabetes: Modern management. New York: Appleton-Century-Crofts, 1980:522-30.

214. Silbert S. Amputation of the lower extremity in diabetes mellitus. Diabetes 1952;1:297-9.

215. Black SA, Ray LA, Markides KS. The prevalence and health burden of self-reported diabetes in older Mexican Americans: Findings from the Hispanic established populations for epidemiologic studies of the elderly. American Journal of Public Health 1999;89:546-52.

216. Stern MP et al. Secular Decline in Death Rates Due to Ischemic-Heart-Disease in Mexican-Americans and Non-Hispanic Whites in Texas, 1970-1980. Circulation 1987;76:1245-50.

217. Becker TM, Wiggins C, Key CR, Samet JM. Ischemic Heart-Disease Mortality in Hispanics, American-Indians, and Non-Hispanic Whites in New-Mexico, 1958-1982. Circulation 1988;78:302-9.

218. Buechley RW, Key CR, Morris DL, Morton WE, Morgan MV. Altitude and Ischemic Heart-Disease in Tricultural New-Mexico - Example of Confounding. American Journal of Epidemiology 1979;109:663-666.

219. Frerichs RR, Chapman JM, Maes EF. Mortality Due to All Causes and to Cardiovascular-Diseases Among 7 Race-Ethnic Populations in Los-Angeles County, 1980. International Journal of Epidemiology 1984;13:291-8.

220. Schoen R, Nelson VE. Mortality by Cause Among Spanish Surnamed Californians, 1969-71. Social Science Quarterly 1981;62:259-74.

221. Goff DC, Ramsey DJ, Labarthe DR, Nichaman MZ. Greater Case-Fatality After Myocardial-Infarction Among Mexican-Americans and Women Than Among Non-Hispanic Whites and Men - the Corpus-Christi Heart Project. American Journal of Epidemiology 1994;139:474-83.

222. Haffner SM, Rosenthal M, Hazuda H, Stern MP, Franco LJ. Evaluation of 3 Potential Screening-Tests for Diabetes-Mellitus in A Biethnic Population. Diabetes Care 1984;7:347-53.

223. Pugh JA, Medina RA, Cornell JC, Basu S. NIDDM is the Major Cause of Diabetic End-Stage Renal-Disease - More Evidence from A Triethnic Community. Diabetes 1995;44:1375-1380.

224. Klein R. Hyperglycemia and Microvascular and Macrovascular Disease in Diabetes. Diabetes Care 1995;18:258-68.

225. Gordis L. Assuring the Quality of Questionnaire Data in Epidemiologic Research. American Journal of Epidemiology 1979;109:21-24.

226. Harlow SD, Linet MS. Agreement Between Questionnaire Data and Medical Records - the Evidence for Accuracy of Recall. American Journal of Epidemiology 1989;129:233-48.

227. Mokdad AH, Bowman BA, Ford ES, Vinicor F, Marks JS, Koplan JP. The continuing epidemics of obesity and diabetes in the United States. JAMA 2001;286:1195-200.

228. Bush TL, Miller SR, Golden AL, Hale WE. Self-Report and Medical Record Report Agreement of Selected Medical Conditions in the Elderly. American Journal of Public Health 1989;79:1554-6.

229. Ngo DL, Marshall LM, Howard RN, Woodward JA, Southwick K, Hedberg K. Agreement between Self-Reported Information and Medical Claims Data on Diagnosed Diabetes in Oregon's Medicaid Population. J Public Health Management Practice 2003;9:542-4.

230. Bergmann MM, Jacobs EJ, Hoffmann K, Boeing H. Agreement of self-reported medical history: Comparison of an in-person interview with a self-administered questionnaire. European Journal of Epidemiology 2004;19:411-6.

231. Okura Y, Urban LH, Mahoney DW, Jacobsen SJ, Rodeheffer RJ. Agreement between self-report questionnaires and medical record data was substantial for diabetes, hypertension, myocardial infarction and stroke but not for heart failure. Journal of Clinical Epidemiology 2004;57:1096-103.

232. Tisnado DM, Adams JL, Liu HH, Damberg CL, Chen WP, Hu FA, Carlisle DM, Mangione CM, Kahn KL. What is the concordance between the medical record and patient self-report as data sources for ambulatory care? Medical Care 2006;44:132-40.

233. Jachuck SJ, Price P, Bound CL. Evaluation of Quality of Contents of General-Practice Records. British Medical Journal 1984;289:26-28.

234. Lloyd SS, Rissing JP. Physician and Coding Errors in Patient Records. JAMA 1985;254:1330-6.

235. Romm FJ, Putnam SM. The Validity of the Medical Record. Medical Care 1981;19:310-5.

236. Demlo LK, Campbell PM, Brown SS. Reliability of Information Abstracted from Patients Medical Records. Medical Care 1978;16:995-1005.

237. U.S.Department of Health and Human Services. Healthy People 2010. 1. 2004.

238. U.S.Department of Health and Human Services. Eliminating racial and ethnic disparities in Health. 2004.

VITA

Max Elias Otiniano was born in Trujillo, Peru on November 06, 1957, the son of Raul and Eva Otiniano. After completing his medical training in 1983 at the Autonomous University of Nuevo Leon in Mexico, he went to Paris, France where he pursued training in Clinical Gerontology at the Pierre et Marie Curie University (Paris VI) for 2 years. Then, he returned to Peru where he gained experience as a Geriatrician in the Geriatric Service of the Navy Hospital and the Institutional Peruvian Social Service Hospital in Lima, Peru. In 1994, he was hired as a Senior Research Assistant at the University of Texas Health Science Center. Since then, he has participated in research projects in Peru, Mexico, and the U.S. He participated in multiple studies focused on Hispanic elderly that increased his awareness of the problems of the elderly.

In 1997, he was accepted into the Master of Public Health Degree program at the University of Texas, Houston-School of Public Health in the International and Family Health concentration.

In 2000, he was accepted as a Post-Doctoral Fellow in Minority Aging at the University of Texas Medical Branch for 2 years. During this training, he participated in research projects that turned into papers published in peer review journals in the areas of diabetes and its complications in Mexican American elders using data from the Hispanic Established Population for Epidemiologic Studies of the Elderly.

In the summer of 2004, he was accepted to pursue a doctoral degree at the University of Texas Medical Branch. To support his education, he wrote a Minority Supplement grant to Dr. Kyriakos Markides, NIA grant focusing on examination of HbA_1c values in Mexican American elders with diabetes and the correlation with complications, disability and short-term mortality.

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LIST OF PUBLICATIONS

1 **Otiniano ME**, Herrera CR, Castillo L. Needs of the Hispanic Elderly Reflect Cultural Differences. *Texas Medicine*. 1996;92 (10) 33-4.

2 **Otiniano ME,** Herrera CR, Hardman-Muye M. Abuse of Hispanic Elders: A Case Study Review. *Clinical Gerontologist*. 1997;18 (1) 39-42.

3 **Otiniano ME.** Diabetes Mellitus en Latinos de Origen Mexicano en Texas. *Gaceta Medica de Mexico*. 1997; (6) 617-19.

4 **Otiniano ME** & Herrera CR. Hispanic Elder Abuse. *Texas Medicine*. 1999; 95 (3) 68-71.

5 **Otiniano ME** & Shajahan M. Ethnic Differences in HIV Testing. *Texas Medicine* 1999;95(9)64-7.

6 **Otiniano ME**, Ray LA, Black SA, Du X, Markides KS. Correlates of diabetic complications in Mexican-American Elders. *Ethnicity & Disease*. 2002;12(2) 252-258.

7 Grimes RM, **Otiniano ME**, Rodriguez M, Lai D. Clinical Experience of HIV Infected Elderly Patients in the Era of Highly Active Antiretroviral Therapy. *Clinical Infectious Disease*. 2002;34(11):1530-3.

8 **Otiniano ME**, Lorimor R, MacDonald E, Du XL. Common fraud experienced by the elderly: Findings from a 1998 survey in Houston, Texas. *Texas Medicine*. 2002; 98(10).

9 **Otiniano ME**, Du XL, Ottenbacher K, Black SA, Markides KS. Lower extremity amputations in Diabetic Mexican American elders: incidence, prevalence and predictors factors. *Journal of Diabetes and its Complications*. 2003;17:59-65.

10 **Otiniano ME**, Du XL, Ottenbacher K, Markides KS. The Effect of Diabetes combined with Stroke on Disability, self-rated Health and Mortality in older Mexican Americans: Results from the Hispanic EPESE. *Arch Phys Med Rehabil*. 2003; 84:725-30.

11 **Otiniano ME**, Ottenbacher K, Markides KS, Ray L, Du XL. Self-Reported Heart Attack in Mexican American Elders: Examination of Incidence, Prevalence, and 7-year Mortality. *JAGS*. 2003;51:923-929.

12 Maldonado MR, **Otiniano ME**, Lee R, Rodriguez L, Balasubramanyam A.. Ethnic differences in β-Cell Functional reserve and clinical features in patients with ketosis-prone diabetes. *Diabetes Care*. 2003;26:2469.

13 **Otiniano ME**, Markides KS, Ottenbacher K, Ray LA, Du XL. Self-Reported Diabetic complications and 7-year Mortality in Mexican American elders: Findings from a Community-Based study of five southwestern states. *Journal of Diabetes and its Complications*. 2003;17:243-248.

14 Maldonado M, **Otiniano ME**, Lee R, Rodriguez L, Balasubramanyam A. Characteristics of Ketosis-Prone Diabetes in a Multiethnic Indigent Community. *Ethnicity & Disease*. 2004;14:243-249.

15 **Otiniano ME**, Du XL, Maldonado MR, Ray L, Markides KS. Effect of Metabolic Syndrome on Heart Attack and Mortality in Mexican American Elderly persons: Findings of 7-year follow-up from the Hispanic Established Population for the Epidemiological Study of the Elderly. *J Gerontology: Medical Sciences.* 2005; 60A:466-470.

16 Maldonado M, D'Amico S, **Otiniano M**, Balasubramanyam A, Rodriguez L, Cuevas E. Predictors of Glycemic Control in Indigent Patients Presenting with Diabetic Ketoacidosis. *Diabetes, Obesity & Metabolism.* 2005;7:282-289.

17 **Otiniano ME**, Balasubramanyam A, Maldonado M. Presence of the Metabolic syndrome distinguishes patients with Ketosis-Prone Diabetes who have a type 2 diabetic phenotype. *J Diabetes and Its Complications.* 2005;19:313-318.

18 Maldonado M, **Otiniano ME**, Cheema F, Rodriguez L. Factors Associated with Insulin Discontinuation in subjects with Ketosis-Prone Diabetes with Preserved β-Cell Function. *Diabetic Medicine*. 2005;22:1744-1750.

19 **Otiniano ME**, Ray L, Goodwin JS, Markides KS. Predictors of poor glycemic control in Mexican American elders with diabetes. Submitted.