Prevalence and Determinants of Type 2 Diabetes Among Filipino-Americans in the Houston, Texas Metropolitan Statistical Area

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OBJECTIVE — The few available studies suggest that Filipino-Americans have an increased risk for developing type 2 diabetes. The purpose of this study was to determine the prevalence of previously diagnosed type 2 diabetes and its major risk factors among Filipino-Americans.

RESEARCH DESIGN AND METHODS — A cross-sectional survey was conducted in the Houston, Texas, metropolitan statistical area between September 1998 and March 2000. The convenience sample included 831 Filipino-American participants aged 20–74 years. The major risk factors assessed were age, sex, family history of diabetes, socioeconomic status, obesity (BMI >30), physical inactivity, acculturation, region of birth and, in women, history of gestational diabetes and delivery of a baby weighing >9 lb.

RESULTS — Overall prevalence was estimated to be 16.1% (95% CI 13.5–18.7). Multivariate logistic regression analyses identified independent risk factors: increasing age from ages 35–44 years (odds ratio [OR] 5.6, 95% CI 1.5–20.5) to 65–74 years (34.2, 7.2–163.0); male sex (1.8, 1.1–32.1); family history of diabetes (4.7, 2.6–8.5); obesity (3.6, 1.4–9.0); region of birth, Mindanao (3.2, 1.3–7.7); and, among women, gestational diabetes (21.7, 6.7–69.7) and low income (5.3, 1.4–20.2).

CONCLUSIONS — The study observed a high prevalence of type 2 diabetes and supports earlier studies suggesting that Filipinos are at higher risk for type 2 diabetes than the U.S. non-Hispanic white population.

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Filipino-Americans, the second largest immigrant population in the U.S., totaled ~1,850,000 in 2000 (1). There were >58,000 Filipino-Americans living in Texas, ~23,000 in the Houston, Texas metropolitan statistical area (MSA). Ethnically, most native Filipinos are a mixture of Malay and Mongol, with some Chinese, Indian, Spanish, and American admixture. Most are proficient in English.

Limited information is available regarding the prevalence of diabetes among Filipino-Americans. The few studies available suggest that Filipinos are among the higher-risk groups for developing type 2 diabetes (2–4). Striking differences in prevalence have been found between different Asian ethnic groups, between migrants and nonmigrants, and between those living in rural and urban settings (5–9). In earlier surveys, prevalence rates among native Filipinos have been estimated to be between 8 and 10% (9). In 1982–1983, a national diabetes survey of 12,297 Filipinos aged 20–65 years was conducted in 44 randomly selected urban and rural communities in the Philippines (10). The survey revealed a crude prevalence of 4.1% (age-adjusted 3.5%). The crude prevalence was 2.5% in rural communities, 6.8% in urban areas, and 8.4% in the capital city of Manila; in the major regions, crude prevalence was as follows: Luzon 3.3%, Visayas 2.5%, and Mindanao 4.6%. More than 50% of cases of diabetes were newly diagnosed.

This cross-sectional study describes the sociodemographic and health characteristics of a convenience sample of Filipino-Americans aged 20–74 years living in the Houston, Texas MSA and estimates the prevalence of previously diagnosed type 2 diabetes. The major type 2 diabetes risk factors assessed included age, sex, family history, socioeconomic status, obesity, physical inactivity, acculturation level and, in women, a history of gestational diabetes or delivery of a baby weighing >9 lb (11,12).

RESEARCH DESIGN AND METHODS

— A cross-sectional survey was conducted in the Houston, Texas MSA between September 1998 and March 2000 to determine the prevalence of previously diagnosed type 2 diabetes and its major risk factors in Filipino-Americans. The convenience sample included people of Filipino origin or ancestry who were residents of Harris, Brazoria, Fort Bend, Liberty, Montgomery, Waller, and Galveston counties at the time of the survey. A questionnaire was developed in English and Tagalog by modifying the National Health and Nutrition Examination Survey (NHANES), the Hispanic Health and Nutrition Examination Survey (HHANES), and the National Health Interview Survey questionnaires (13–15) to make a more culturally appropriate form for Filipino-Americans. Demographic characteristics, family history,

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Abbreviations: HHANES, Hispanic Health and Nutrition Examination Survey; MSA, metropolitan statistical area; NHANES, National Health and Nutrition Examination Survey; OR, odds ratio.
A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

health status, and acculturation-related data were collected. Definitions of the data items are included in the APPENDIX.

To promote survey participation, information was disseminated to the Filipino-American community through posters and fliers in businesses and other organizations catering to Filipino-Americans, and information was published in Philippine newspapers. Support was obtained from the Filipino-American Council of South Texas, the coordinating body for Filipino-American organizations in the Houston area. Representatives of each member organization were contacted by the principal investigator to inform them about the survey and to seek help in recruiting participants.

Questionnaires were distributed at community events, church gatherings, Filipino businesses, health fairs, organizations' meetings, and individual homes. Study participants either completed the questionnaires on site or returned them by mail. A total of 2,439 survey questionnaires were distributed. Of the 876 respondents, 831 adults aged 20–74 years were included in the final analysis; 43 individuals outside the age range were excluded, as well as one non-Filipino individual and one individual with type 1 diabetes diagnosed at age 13 years.

Statistical analysis

Missing data items were imputed for 19 (2.3%) survey participants by using other information in their questionnaires. Poststratification weighting adjustment was made based on the 1996 Filipino-American population estimates (U.S. Census Bureau) (16). The weighting procedure ensures that the age and sex distributions of the convenience sample and the Filipino-American population are identical. In this sample, bias toward women, increased age, and to an extent, higher education was corrected.

Logistic regression analyses were performed to calculate odds ratios (ORs) and 95% CIs for each risk factor. Nine risk factors were tested in the models for the full sample: age, sex, family history of diabetes, obesity, physical inactivity, household income, educational attainment, acculturation, and region of birth. A separate analysis was repeated in the subset of women to include history of gestational diabetes and delivery of a baby weighing >9 lb. To determine the effect of missing data on the results, both univariate and multivariate regression analyses were repeated by including only respondents without any missing data. The models showed similar results with the same risk factors identified.

RESULTS — Of 831 Filipino-American survey participants, 96% were first-generation immigrants who were born in the Philippines and have lived in the U.S. between 1 and 46 years (mean 17.0 ± 9.5). The mean age was 46.1 ± 12.0 years; a higher percentage of men (60.1%) than women (51.7%) in this sample were aged ≥45 years ($P = 0.021$). The mean BMI was 24.6 ± 3.6 kg/m^2 (range 9–47). The population distribution according to education, income, and employment indicated that a high proportion of the survey participants were in the upper socioeconomic groups, with an average of two household members receiving an income. Based on the responses to language-related questions, most participants spoke (80%), read (97%), and wrote (94%) equally well or better in English than in the Filipino language or dialect. The mean acculturation score was 2.8 ± 0.5 (range 1–4); a score of "4" means "mostly American." Only 55 (7%) of the survey participants scored "4" and 5 participants scored "1".

Of the 831 study participants, 125 had been previously diagnosed with type 2 diabetes; the median duration of diabetes was 4 years. Prevalence of known type 2 diabetes was based on the respondents' self-report of having been diagnosed with diabetes by a physician or other health professionals using the same questions that were used in the NHANES, i.e., "Have you ever been told by a physician that you had diabetes or high blood glucose?" or "Have you ever been told by any other health professional that you had diabetes or high blood glucose?" Presence of diabetes was confirmed by questions regarding the year and/or individual's age at diagnosis of diabetes, blood and oral glucose tolerance testing, therapy used, frequency of blood tests, and doctor's visits. A "yes" response to questions about borderline/potential diabetes or prediabetes distinguished patients with only impaired glucose tolerance and not diabetes.

The diabetic respondents were significantly older than the nondiabetic respondents ($P < 0.0001$); mean ages of the diabetic and nondiabetic respondents were 54.5 and 44.4 years, respectively. Similarly, the mean BMI was significantly higher ($P < 0.0001$) for diabetic individuals (26.1 kg/m^2) than for nondiabetic individuals (24.4 kg/m^2). A total of 21% of responders had a paternal history of diabetes, 25% a maternal history, and 20.6% had at least one sibling with diabetes.

The prevalence rates of diabetes were significantly higher for the major risk factors: older age (≥35 years), positive family history of diabetes, obesity (BMI >30), low acculturation level, gestational diabetes, and a history of delivering a baby weighing >9 lb (Table 1). In each group, except for participants ages 35–44 years, prevalence rates were higher in men than women.

The results of the univariate and multivariate analyses to determine the effects of the established risk factors on type 2 diabetes are presented in Table 1. The 20- to 34-year age group was used as the referent population for all other age groups. Older age, male sex, family history of diabetes, obesity, and being born in Mindanao were found to be independent risk factors, with older age being the strongest risk factor, and male sex showing the weakest association. While univariate analysis revealed no statistical significance for region of birth, after controlling for other factors, a significant effect on diabetes risk was found. On the other hand, household income <$20,000 was associated with diabetes univariately but was not a significant risk factor when controlled for all other factors. The preponderance of participants who were highly educated and with high income resulted in small numbers in the other group, thereby reducing power to assess this association. The results among women clearly demonstrate the association of the important risk factors, i.e., older age and gestational diabetes (Table 2). In addition, low household income level became significant when controlled for other risk factors.

CONCLUSIONS — A type 2 diabetes prevalence rate of 16.1% (95% CI 13.5–18.7) was estimated from a convenience sample of Filipino-Americans in the Houston MSA. This rate is much higher than the 1998 U.S. prevalence rate of 6.5% (17), which, if adjusted to the Filipino-Americans' age distribution, yielded 6.2%. In both populations, prevalence increased at every decade of life and was higher among individuals who were

Table 1—*Type 2 diabetes prevalence rates and effects of major risk factors in Filipino-Americans (age 20–74 years)*

Risk factor	Percentage of participants* (n = 708–822)	Weighted prevalence† % (95% CI)	Univariate analysis* (n = 696–747) OR	Univariate analysis* (n = 696–747) 95% CI	Multivariate analysis (n = 539) OR	Multivariate analysis (n = 539) 95% CI
Age (years)						
20–34‡	18.8	3.7 (0.6–6.8)	1.00		1.00	
35–44	26.2	10.1 (5.8–14.4)	3.19	1.17–8.72	5.55	1.50–20.52
45–54	30.9	16.1 (11.4–20.8)	5.10	1.95–13.31	6.46	1.79–23.29
55–64	17.7	23.8 (16.6–31.0)	8.23	3.09–21.88	6.98	1.84–26.46
65–74	6.4	56.3 (41.8–70.8)	34.50	11.85–100.42	34.19	7.17–162.99
Sex						
Female‡	61.3	13.1 (10.0–16.2)	1.00		1.00	
Male	38.7	19.7 (15.1–24.3)	1.65	1.11–2.46	1.80	1.05–32.09
Family history of diabetes						
No‡	54.7	6.4 (3.9–8.9)	1.00		1.00	
Yes	45.3	25.5 (20.7–30.3)	4.41	2.75–7.09	4.69	2.59–8.52
Obesity						
BMI ≤30‡	94.6	15.1 (12.4–17.8)	1.00		1.00	
BMI >30	5.4	30.0 (16.6–43.4)	2.67	1.37–5.20	3.56	1.40–9.04
Physical activity						
Sedentary‡	29.0	13.0 (8.5–17.5)	1.00		1.00	
Moderate or high	71.0	17.0 (13.8–20.2)	0.79	0.50–1.25	1.15	0.64–2.05
Education						
Above high school‡	97.0	14.9 (12.2–17.6)	1.00		1.00	
High school or lower	3.0	23.6 (4.5–42.7)	1.27	0.57–2.81	0.46	0.12–1.78
Household income						
≥$20,000‡	92.9	14.5 (11.7–17.3)	1.00		1.00	
<$20,000	7.1	28.2 (15.2–41.2)	1.80	1.09–2.96	2.50	0.88–7.14
Acculturation						
High‡	6.9	5.1 (0.0–11.0)	1.00		1.00	
Middle or low	93.1	17.0 (14.1–19.8)	1.16	0.80–1.67	0.57	0.13–2.45
Region of birth						
Luzon, Visayas, Manila‡	93.3	16.0 (13.2–18.8)	1.00		1.00	
Mindanao	6.7	27.5 (14.6–40.4)	1.94	0.97–3.87	3.18	1.31–7.71

*n varies due to missing values; †standard population: Filipino immigrant population in the U.S. (Bureau of the Census Current Population Survey, 1996); ‡referent population.

obese or with lower education. Whereas the rate was higher among women in the U.S. population, it was higher among Filipino-American men. The estimated rate for Filipino-Americans in this survey is three times the Philippines' prevalence rate of 5.3% (adjusted to the same age distribution) (10). The designs of the two studies are different, and nearly two decades separate the data collection; therefore, it is important to resolve the contribution of spatial and temporal trends to the observed difference. The dramatic increase in the diabetes mortality rate in the Philippines (5.1–9.8 per 1,000) from 1986 to 1995 is consistent with the native population experiencing an increase in the prevalence of diabetes (18). A probability sample survey of Filipino-Americans and a contemporary prevalence survey in the Philippines would allow resolution of this issue.

The relatively high prevalence of diabetes among the Filipino-Americans surveyed is consistent with the results of a study of 527 Filipino-Americans and 3,176 Caucasians who underwent percutaneous coronary intervention or coronary artery bypass at a hospital in Daly City, CA, between 1992 and 1996 (19). The study showed that Filipino-Americans had a significantly higher frequency of diabetes (34.7 vs. 24.1%; $P < 0.001$) and hypertension (79 vs. 61%; $P < 0.0001$). However, they had a significantly lower prevalence of obesity and smoking. History of diabetes and Filipino-American ethnicity were among the independent predictors of mortality after cardiac surgery, which increased the need for repeat revascularization. The data from this survey are also consistent with the increasing prevalence (33%) of diabetes from 1990 to 1998 in all populations in the U.S. (17). Individuals aged 30–39 years and with higher education had the largest increases: 76 and 64%, respectively.

Risk factors

This survey of Filipino-Americans, like earlier surveys, showed that increasing age is the strongest risk factor for diabetes. The prevalence of diabetes was high as early as the third decade. Unlike other population studies, the risks in this population were similar in each decade of life, except at ages 65–74 years, when there is a sharp increase. Among women in this study, risks were higher in earlier decades of life, with the same rapid increase at age

Table 2—*Effects of major risk factors on type 2 diabetes in Filipino-American women (aged 20–74 years)*

	Univariate analysis* (n = 443–472)		Multivariate analysis (n = 315)	
Risk factor	OR	95% CI	OR	95% CI
Age (years)†				
35–44	4.01	1.12–14.28	10.79	1.00–16.83
45–54	4.37	1.26–15.21	16.17	1.42–184.03
55–64	5.93	1.59–22.21	14.65	1.09–97.70
65 and older	27.66	7.11–122.97	38.68	2.27–659.89
Gestational diabetes	14.06	6.1–32.41	21.65	6.73–69.67
Delivery of baby weighing >9 lb	4.13	1.87–9.11	1.51	0.39–5.84
Family history of diabetes	3.16	1.69–5.89	2.22	0.92–5.35
Obesity† (BMI >30 kg/m^2)	3.82	1.47–9.94	2.85	0.53–15.4
Physical activity†	1.07	0.59–1.93	1.18	0.49–2.84
Education:† high school level or lower	0.92	0.21–4.12	0.82	0.08–8.77
Household income:† <$20,000	2.68	1.07–6.70	5.28	1.38–20.19
Acculturation level:† low/middle		(No cases of diabetes)		
Region of birth:† Mindanao	1.08	0.36–3.25	1.88	0.48–7.30

*n varies due to missing values; †referent populations (shown in Table 1).

65–74 years. Nevertheless, when other factors were adjusted for, there was little evidence that risk differs between men and women, similar to what has been shown for native Filipinos (10).

Familial clustering of diabetes has been demonstrated in some populations (20). Excess maternal transmission was seen in all races: Asian/Pacific Islanders, Hispanics, African-Americans, and non-Hispanic whites. Among the Filipino-American survey participants, diabetes had been diagnosed in either parent (37.5%), both parents (6.2%), or one or more siblings (20%). Similarly, among native Filipinos (10), 30% had one or two diabetic parents and 14% had one or more diabetic siblings. These rates of familial diabetes are higher than those observed in the U.S. NHANES II population (21).

The mean BMI of the NHANES II diabetic population was 28.1 kg/m^2 (21); the mean BMI of the diabetic group in this survey was lower (26.1 kg/m^2). Furthermore, the proportion of participants in the NHANES II diabetic population who were obese was higher, particularly among women, compared with the diabetic Filipino-Americans. Obesity is prevalent in ethnic minorities, but obesity alone does not explain the increased prevalence of diabetes (22). Genetics and factors other than obesity must be affecting the diabetes risk in this generally nonobese Filipino-American population. Because of their inherent genetic predisposition to diabetes, it may be that Asians are particularly susceptible to changes accompanying migration and Westernization.

Higher acculturation to mainstream American society is associated with decreased prevalence of diabetes; however, increased Westernization leads to increased diabetes risk (23). The significance of acculturation has been explained as the "descending limb" of modernization, in which those who are more affluent avoid unhealthy factors associated with the "ascending limb," such as increased calorie consumption, decreased consumption of dietary fiber, and decreased physical activity.

These are the first data on diabetes from a survey that was designed to estimate the prevalence and risk factors of type 2 diabetes among Filipino-American adults. The limitations of this study should be carefully considered when interpreting the results. The use of a convenience sample, instead of a probability sample, and the participation rate are potential weaknesses of the study. Diabetic and highly educated individuals with interest in the study as well as medical professionals may have been more likely to participate and therefore may be overrepresented. The extent of participation bias, however, is probably small, because the strong associations of well-known risk factors for diabetes found in this study were consistent with previous studies.

In summary, the results of this survey of Filipino-Americans in the Houston MSA strongly support much earlier studies suggesting that Filipinos are at greater risk for developing type 2 diabetes. The prevalence is much higher than those reported by other population and community surveys. Although differences in study design, time period, age groups, sample size, and response rate must be carefully considered when any comparisons are made, these results indicate the need for more detailed studies of a representative sample of Filipino-Americans, with careful attention to indicators of Westernization.

APPENDIX

Definitions

Family history of diabetes was defined as having a parent or a sibling who had been diagnosed with diabetes. History of gestational diabetes was ascertained by a "yes" response to "Have you ever been told by a physician that you had diabetes when you were pregnant?", the same question that was used in the NHANES.

BMI was computed, as in the NHANES II and HHANES, using self-reported weight in kilograms divided by height in meters squared (21). Self-reported BMI is a commonly used measure of obesity. Overall obesity was defined as BMI >30 kg/m^2. A respondent was classified as physically active if the person engaged in any exercise, sports, or physically active hobbies ≥4 times per week for at least 20 min; "moderately active" was determined

by physical activity 1–3 times per week, and "sedentary" was considered physical activity less than once per week or no activity. Educational attainment and household income were the surrogate items for socioeconomic status (11,12).

A six-item acculturation score, similar to the Cuellar scale (24) used in the NHANES questionnaire, was used to represent the concept of acculturation. The score was the arithmetic mean of the codes of six data items; the minimum "1" represented the strongest Filipino orientation, the maximum "5" represented the strongest American orientation, and "3" represented equally Filipino and American orientation. The first four items represented language ability and preference in speaking, reading, and writing. The fifth item identified the generation: a respondent who was born in the Philippines was considered a first-generation immigrant, whereas someone born in the U.S. or any other country, with one or both parents born in the Philippines, was a second-generation immigrant. Food preference was the sixth item incorporated into the score. Based on the scores, the respondents were then grouped into three acculturation levels: high, middle, and low.

For purposes of comparability with the Philippine survey on diabetes, a respondent's place of birth in the Philippines was classified as the country's capital, Manila, or one of three major regions: Luzon (north), Visayas (central), or Mindanao (south).

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