The Prevalence of NIDDM and Associated Coronary Risk Factors in Mexico City

CARLOS POSADAS-ROMERO, MD
LIRIA YAMAMOTO-KIMURA, MD, PHD
ISRAEL LERMAN-GARBER, MD
JOSÉ ZAMORA-GONZALEZ, BS
ARTURO FAJARDO-GUTIERREZ, MD, MSC
LEORA VELAZQUEZ, MD
GUILLERMO CARDOSO-SALDAÑA, BS

OBJECTIVE — To determine the prevalence of diabetes and associated coronary risk factors in the Mexico City population.

RESEARCH DESIGN AND METHODS — A sample of 805 adults was selected from Mexico City. The participants, 20–90 years of age and living in the city, were selected by the method of multistage cluster sampling with proportional allocation. Diabetes was diagnosed by previous history or if fasting blood glucose was ≥7.8 mmol/l (≥140 mg/dl).

RESULTS — The crude rate prevalence of NIDDM was 8.7%, with an age-adjusted rate of 10.6% for women and 6.0% for men. Age strongly influenced diabetes prevalence, with a χ^2 of risk tendency of 39.1 ($P < 0.00005$). A significant proportion (5.9%) of younger individuals (35–44 years of age) was affected by the disease. Diabetes was associated with advanced age, had a greater impact in the low-income group, and showed increased odds ratio for hypertension, dyslipidemias, and myocardial infarction in men and women and for obesity only in women.

CONCLUSION — There is a high prevalence of NIDDM in Mexico City that also strikes a significant group of younger individuals. Associated coronary risk factors are also common and more prevalent in diabetic individuals. Current epidemiological data in Mexico and Mexican-Americans in the U.S. suggest that we may be on the ascending limb for diabetes and cardiovascular disease. There is a critical need for resources to be allocated to programs for primary and secondary prevention, which must be well structured and organized so that proper standards of care are followed to prevent progression of the disease.

From the Departamento de Endocrinología Instituto Nacional de Cardiología Ignacio Chávez (C.P.-R., I.L.-G., J.Z.-G., G.C.-S.); Departamento de Salud Pública (L.Y.-K., L.V.), Universidad Nacional Autónoma de México; and Unidad de Investigación en Epidemiología (A.F.-G.), Hospital de Pediatría CMN, Siglo XXI, IMSS, Mexico City, Mexico.

Address correspondence and reprint requests to Carlos Posadas-Romero, MD, Departamento de Endocrinología, Instituto Nacional de Cardiología Ignacio Chávez, Juan Badiano #1, Tlalpan, 14080 México City, México.

Received for publication 19 October 1993 and accepted in revised form 30 June 1994.

NIDDM, non-insulin-dependent diabetes mellitus; CI, confidence interval; CCDIF, Community Center for Integrated Development of the Family; WHR, waist-to-hip ratio; BMI, body mass index; HDL, high-density lipoprotein; VLDL, very-low-density lipoprotein; LDL, low-density lipoprotein; CV, coefficient of variation; WHO, World Health Organization; sBP, systolic blood pressure; dBP, diastolic blood pressure; ANOVA, analysis of variance; OR, odds ratio; SES, socioeconomic status.

The prevalence of non-insulin-dependent diabetes mellitus (NIDDM) varies widely. Populations of developing countries, minority groups, and disadvantaged communities in industrialized countries now face the greatest risk (1). Projections made from current epidemiological data in Mexican-American populations suggest that the incidence of NIDDM will continue to escalate in this ethnic group, closely related to the increased rates of obesity, the genetic background, and the trend for diminished physical activity (2–6). Diabetes-related complications will also occur more frequently because of the early appearance of the disease, its underdiagnosis and undertreatment, and the high prevalence of hypertension, dyslipidemias, and smoking (7–12).

Mexico is probably on the ascending limb of the diabetes epidemic. In the early 1960s, several reports in nonrepresentative groups of Mexican individuals disclosed a prevalence of diabetes in ranges of 2–3% (13,14). In recent years, there has been a growing concern that NIDDM is becoming more common in Mexico. It is one of the leading causes for hospital admissions and outpatient visits in health care facilities and one of the main causes of death (15). Recently, a survey in a low-income neighborhood in Mexico City disclosed a prevalence of NIDDM two to three times higher than the prevalance in non-Hispanic whites in the U.S., but still significantly lower than that in Mexican-Americans (6). These considerations indicate that continuing study of NIDDM in Mexico is warranted (16). The objective of this study was to determine the prevalence of diabetes and associated coronary risk factors in a random sample of the Mexico City population.

RESEARCH DESIGN AND METHODS

— Mexico City is one of the largest and more crowded cities in the world. Its population has a genetic admixture mainly from the indigenous Indians mixing with Spaniards (mestizos).

Population sample

The Mexico City metropolitan area is one of the largest in the world and is located in two federal entities of the Mexican Republic: the Federal District and the State of Mexico. This study included as a reference population only residents of the Federal District, which is integrated by 16 political districts. This cross-sectional survey was conducted from January 1991 to March 1992 and included the adult population 20 years of age and older. Sample size was calculated with a confidence interval (CI) of 95%, a maximum tolerated error of 2%, and prevalence of 10%. The sample size under these conditions was 864 individuals, the response rate was 94.7%, and in 13 subjects the blood sample was lost. Thus, the results for 805 subjects (430 men and 375 women) are reported.

According to the particular features of Mexico City and of the variables to be studied, a random multiple-stage design was chosen. During the first stage, the population was divided into two groups: the economically active and inactive populations according to the data from the General Census of 1990. The economically active group was formed by workers who labor in 16 of the 19 main occupations described in the Economic Census of 1986. The economically inactive group consisted of students, housewives, and pensioned and unemployed individuals. During the second stage, lists of industries, universities, government offices, and workshops were gathered from the telephone directory, and seven working centers where the main occupations exist were randomly selected. Three industries from which 10 occupations were represented were chosen (steel factory, soft drink, and textile); one university was selected to study the administrative and professional employees; one government office contributed with workers of seven different occupations; employees from a shop and from a workshop were also included. A group of workers dedicated to the following 16 activities was formed: professionals, technical and specialized personnel, teachers, art workers, government employees, private managers, labor worker supervisors, artisans and laborers, labor helpers, office employees, salesmen, independent salesmen, service employees, domestic workers, transport operators, and protection and vigilance personnel. Because agriculture is not a significant activity in Mexico City, no farmers were included. Samples for the economically inactive population were obtained from four high schools, one school for advanced studies, and one Community Center for Integrated Development of the Family (CCDIF) (pensioned and unemployed people). School centers were randomly selected from a list of public and private schools provided by the Secretaría de Educación Pública (Public Education Ministry), and the CCDIF was chosen in the same way from a list provided by the CCDIF System. For the third stage, lists of workers, students, or participants were requested from each selected organization, and unitary samples were then randomly chosen. In high schools, students, parents, and relatives >20 years of age with no earnings were studied. Authorization was requested in all cases to perform the study. A special place was adapted to apply the questionnaire and perform all measurements and studies. The protocol of this study was authorized by the Research and Ethics Committee of the Instituto Nacional de Cardiología Ignacio Chávez.

Anthropometric measurements

On the day of blood sampling and after an overnight fast, all anthropometric measurements were performed by a single observer at the site of examination between 9 and 11 A.M. Participants removed their shoes and upper garments and donned an examining gown. Height was measured to the nearest 0.5 cm. Waist circumference was measured on subjects in the standing position, at the end of gentle expiration, at a level midway between lower rib margin and the iliac crest. Hip circumference was measured at the thickest part over the great trochanters. Both circumferences were measured in duplicate with a steel tape to the nearest 0.5 cm. Body weight was measured on a daily calibrated lever balance and recorded to the nearest 0.1 kg. Body mass index (BMI) was calculated as weight (kg) divided by height (m^2) and was used as an index of overall adiposity. The waist-to-hip ratio (WHR) was used as measure of body fat distribution.

Blood chemistry studies

At the baseline examination, blood specimens were obtained after a 12- to 14-h fast for determination of plasma lipids, lipoproteins, insulin, and glucose concentrations. Plasma glucose was analyzed by the glucose-oxidase method (Boehringer Mannheim, Indianapolis, IN). The plasma concentrations of total cholesterol and triglycerides were determined by enzymatic methods (Boehringer Mannheim). High-density lipoprotein (HDL) cholesterol was measured after precipitation of very-low-density lipoprotein (VLDL) and low-density lipoprotein (LDL) by the phosphotungstate method (Boehringer Mannheim), and LDL cholesterol was estimated by the formula of Friedewald. Intra-assay coefficient of variation (CV) values for total cholesterol, triglycerides, and HDL cholesterol were 1.1, 0.62, and 1.14, respectively; and the inter-assay CV values were 3.06, 2.6, and 3.9%, respectively. Our laboratory participates in the Lipid Standardization Program of the Centers for Disease Control in Atlanta, GA.

Insulin was analyzed by enzyme-linked immunosorbent assay in an ES-33 system (Boehringer Mannheim) with intra-assay and inter-assay CV values of 2.1 and 6.8%, respectively. The cross-reactivity with proinsulin for this assay was 40%. Lipoprotein(a) was measured by enzyme-linked immunosorbent assay (Boehringer Mannheim) with intra-assay and inter-assay CV values <10%.

Definitions

Diabetes mellitus was diagnosed according to the World Health Organization (WHO) criteria (fasting plasma glucose

Table 1—*Age-adjusted anthropometric variables*

	Men	Women	*P* values
n	430	375	
Weight (kg)	71.6 ± 12.1	62.5 ± 11.2	<0.001
Height (cm)	165.3 ± 6.8	153.0 ± 6.5	<0.001
Waist (cm)	91.2 ± 10.7	85.4 ± 11.9	<0.001
Hip (cm)	95.1 ± 7.4	98.4 ± 10.1	<0.005
BMI (kg/m^2)	26.1 ± 3.6	26.7 ± 4.5	<0.05
WHR	0.957 ± 0.067	0.864 ± 0.072	<0.001
sBP (mmHg)	122.2 ± 16.8	118.6 ± 18.0	<0.005
dBP (mmHg)	77.5 ± 11.2	74.8 ± 11.4	<0.005

Data are means ± SD. *P* values determined by ANOVA.

level ≥7.8 mmol/l [≥140 mg/dl]). Subjects who did not meet this criterion but in whom diabetes had been diagnosed previously and were under treatment with diet, oral agents, or insulin, were also considered to have diabetes. Insulin-taking diabetic subjects whose age of onset was >40 years or whose BMI was >30 kg/m^2 were also considered to have NIDDM.

For the purpose of the study and because of the lack of an oral glucose tolerance test, those with a fasting blood glucose level <6.1 mmol/l (110 mg/dl) and without a personal history of diabetes were considered to be nondiabetic individuals.

Systolic (first-phase) blood pressure (sBP) and diastolic (fifth-phase) blood pressure (dBP) were measured to the nearest even digit with a mercury sphygmomanometer. Three readings were recorded for each individual, and the average of the second and third readings was defined as the subject's BP. Hypertension was defined according to the WHO criteria (dBP > 90 mmHg and/or current use of antihypertensive medications). Systolic hypertension was defined as a sBP of >140 mmHg.

Smoking was considered to be present when the subject smoked ≥10 cigarettes per day.

Ischemic heart disease was considered if a patient had a history of myocardial infarction. Socioeconomic status was divided into low, medium, and high income groups on basis of income: low, <3 minimum salaries; medium, 3–7 minimum salaries; and high, >7 minimum salaries. At the present time in Mexico, 3 minimum salaries represents an income of approximately $450/month. Those individuals in the low-income group live in poverty with the possibility of satisfying only their basic needs. Those in the medium-income group can satisfy their fundamental needs but cannot save money for other purposes, and those in the high-income group are not necessarily rich but have the possibility of saving money and owning properties.

Hypertriglyceridemia was considered to be a triglyceride concentration ≥2.26 mmol/l (≥200 mg/dl) as recommended by the National Institutes of Health Consensus Conference on hypertriglyceridemia. An LDL cholesterol level ≥4.13 mmol/l (≥160 mg/dl) was considered to be hypercholesterolemia. This end point corresponds to the high-risk category of the National Cholesterol Education Program. HDL concentration was considered to be abnormal if it was <0.90 mmol/l (<35 mg/dl) in men and <1.16 mmol/l (<45 mg/dl) in women.

Table 2—*Age-adjusted metabolic variables*

	Men	Women	*P* values
n	430	375	
Total cholesterol (mmol/l)	5.37 ± 1.13	5.33 ± 0.91	NS
Triglycerides (mmol/l)	1.91 ± 1.07	1.63 ± 0.84	<0.001
LDL cholesterol (mmol/l)	3.64 ± 0.99	3.52 ± 0.80	NS
HDL cholesterol (mmol/l)	1.04 ± 0.28	1.22 ± 0.31	<0.001
LDL cholesterol/HDL	3.76 ± 1.69	3.07 ± 1.03	<0.001
Glucose (mmol/l)	5.04 ± 0.44	4.99 ± 0.41	NS
Insulin (μU/ml)	10.8 ± 15.6	11.3 ± 8.9	<0.01
Lipoprotein (a) (mg/dl)	17.0 ± 26.9	19.3 ± 32.6	NS

Data are means ± SD. *P* values determined by ANOVA. For glucose and insulin, subjects with NIDDM and those with blood glucose values >6.1 mmol/l were excluded.

Statistical analysis

Direct age-adjusted prevalence of NIDDM was calculated, and the statistical significance was tested with the Mantel Haenszel χ^2 statistic and trend analysis. The anthropometric and metabolic variables were adjusted for age by a direct method using subjects residing in Mexico City as a standard population according to the National Census of 1990, information obtained from the Instituto Nacional de Estadística, Geografía e Informática. Significance of differences across groups was assessed by analysis of variance (ANOVA). Odds ratios (ORs) estimating the association of NIDDM with other risk factors were calculated. Tertile levels for BMI and WHR were defined for both sexes separately as follows: BMI for men: 1, <24.20 kg/m^2; 2, 24.20–26.89 kg/m^2; 3, >26.89 kg/m^2; BMI for women: 1, <24.32 kg/m^2; 2, 24.32–27.68 kg/m^2; 3, >27.68 kg/m^2; WHR for men: 1, <0.93; 2, 0.93–0.98; 3, >0.98; WHR for women: 1, <0.83; 2, 0.83–0.89; 3, >0.89.

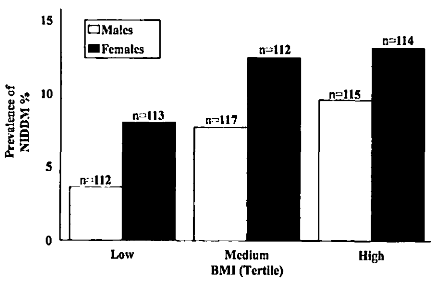

Figure 1—*Age-standardized prevalence (%) of NIDDM in Mexico City men and women stratified by tertiles of BMI. The χ^2 values of tendency related to BMI were 1.31 (NS) for men and 3.27 (NS) for women.*

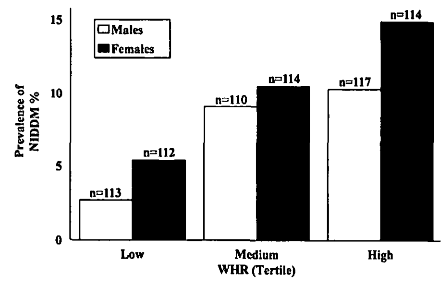

Figure 2—*Age-standardized prevalence (%) of NIDDM in Mexico City men and women stratified by tertiles of WHR. The χ^2 values of tendency were 4.03 (P < 0.05) for men and 6.75 (P < 0.01) for women.*

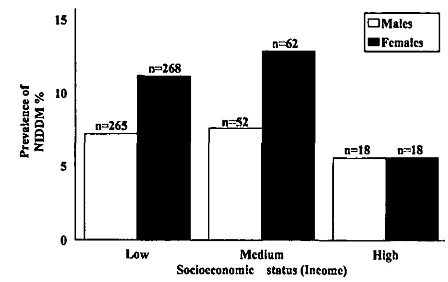

Figure 3—*Age-standardized prevalence (%) of NIDDM in Mexico City men and women stratified by SES.*

These levels were correlated with the presence of NIDDM. Statistical analyses were obtained with Epi Software (Version 5.0) by the Centers for Disease Control.

RESULTS— Table 1 shows anthropometric data and mean BPs, and Table 2 shows age-adjusted metabolic variables of the whole population studied divided by sex. Men were significantly younger (40 ± 13 vs. 42 ± 12 years old, $P < 0.05$), had higher mean sBPs and dBPs, increased mean plasma triglyceride levels and LDL/HDL cholesterol ratios, and a lower HDL cholesterol level. Women were more obese and had higher mean plasma insulin levels.

Table 3 shows diabetes prevalence by age-group and sex. The crude prevalence was 8.7%, with an age-adjusted rate of 10.6% for women and 6.0% for men. Age strongly influenced diabetes prevalence, with a χ^2 of risk tendency of 39.1 ($P < 0.001$). Particularly relevant was that a significant group (5.9%) of younger individuals (35–44 years of age) was affected by the disease.

Obesity, particularly central obesity, has long been associated with NIDDM, and to assess whether the higher BMI and/or WHR could account for the higher prevalence of NIDDM, age-standardized prevalence of NIDDM was calculated after stratification by tertiles of the BMI and WHR distribution for each sex (Figs. 1 and 2). Differences are evident with a trend for an increased prevalence of diabetes with increased BMI and WHR. The χ^2 values of tendency related to BMI were 1.31 (NS) for men and 3.27 (NS) for women and to WHR were 4.03 ($P < 0.05$) and 6.75 ($P < 0.01$), respectively.

The prevalence of diabetes by gender and socioeconomic status (SES) stratified as low-, medium-, and high-income groups is shown in Fig. 3. Increased and similar prevalences were found in the low- and medium-income groups. The high-income group consisted of a small number of subjects ($n = 36$) who had a lower prevalence of NIDDM (P = NS).

The association of NIDDM with other variables was estimated using ORs (Table 4). Diabetes was associated with advanced age, myocardial infarction, hypertension, and dyslipidemias (high LDL cholesterol, hypertriglyceridemia, and low HDL cholesterol) in both men and

Table 3—*Prevalence of NIDDM by age-group and sex*

	Men		Women		Total	
	All	NIDDM	All	NIDDM	All	NIDDM
Age-group (years)						
20–34	164	2 (1.2)	109	4 (3.7)	273	6 (2.2)
35–44	98	5 (5.1)	140	9 (6.4)	238	14 (5.9)
45–54	74	6 (8.1)	53	9 (17.0)	127	15 (11.8)
55–64	33	10 (30.3)	35	12 (34.3)	68	22 (32.3)
65+	25	3 (12.0)	26	6 (23.1)	51	9 (17.6)
Crude rate	394	26 (6.6)	363	40 (11.0)	757	66 (8.7)
Age-adjusted rate (%)		6.08		10.6		8.14

Data are *n* for all patients and *n* (%) for patients with diabetes. Patients in 6.1–7.7 mmol/l glucose range were excluded.

Table 4—*Diabetes and its associations with some clinical conditions and other metabolic variables*

	Men				Women			
	Diabetes	No diabetes	OR	CI	Diabetes	No diabetes	OR	CI
Age								
≥ 50 years	16	72	6.58	2.66–16.49	23	60	5.93	2.82–12.55
< 50 years	10	296			17	263		
Myocardial infarction								
Yes	1	4	4.10	0.42–42.65	3	4	6.63	1.11–37.4
No	22	361			36	318		
BMI								
≥ 27 kg/m^2	11	102	1.81	0.72–4.52	17	120	1.22	0.58–2.55
< 27 kg/m^2	13	208			21	301		
Hypertensive								
Yes	7	58	1.97	0.71–5.29	19	77	2.89	1.39–5.99
No	19	310			21	246		
Smokers								
Yes	3	39	1.10	0.25–4.15	0	6	—	—
No	23	368			40	323		
LDL cholesterol								
≥4.13 mmol/l	10	91	1.90	0.77–4.67	10	68	1.25	0.54–2.85
<4.13 mmol/l	16	277			30	255		
Low HDL								
Yes	10	115	1.38	0.56–3.35	21	138	1.48	0.73–3.03
No	16	253			19	185		
Triglycerides								
≥2.26 mmol/l	12	104	2.18	0.90–5.23	16	43	4.34	2.00–9.40
<2.26 mmol/l	14	368			24	280		

No diabetes, no previous diagnosis of diabetes and fasting blood glucose level < 6.1 mmol/l. Smokers, current smokers of 10 or more cigarettes per day. Hypertensive, dBP > 90 mmHg or previous diagnosis and use of antihypertensive medication. Low HDL cholesterol, < 0.90 mmol/l for men and < 1.16 mmol/l for women.

women and with obesity only in women. The prevalence of hypertension was 27 and 47% in diabetic men and women, respectively, versus 16 and 24% in nondiabetic individuals ($P < 0.005$ when diabetic and nondiabetic women were compared). Hypercholesterolemia was found in 38 and 25% of diabetic men and women vs. 25 and 21% of nondiabetic individuals (P = NS), hypertriglyceridemia in 46 and 40% vs. 22 and 13% ($P < 0.05$, $P < 0.001$, respectively), and hy-

Table 5—*Age-adjusted anthropometric and physiological variables by SES*

	Diabetes			No diabetes		
	SES			SES		
	Low	Medium	High	Low	Medium	High
n	49	12	2	484	102	34
sBP (mmHg)	128 ± 23	126 ± 19	142 ± 15	119 ± 16*	120 ± 18	122 ± 19
dBP (mmHg)	81 ± 14	84 ± 9	87 ± 6	75 ± 11†	76 ± 12†	75 ± 12
BMI (kg/m^2)	26.8 ± 3.6	31.4 ± 7.8	30.8 ± 0.24‡	26.3 ± 4.0	26.0 ± 3.9§	25.1 ± 3.6†
WHR	0.93 ± 0.07	0.90 ± 0.06	0.93 ± 0.11	0.91 ± 0.08†	0.89 ± 0.09	0.87 ± 0.07‖

Data are means ± SD. *$P < 0.005$ vs. diabetes (ANOVA). †$P < 0.05$ vs. diabetes (ANOVA). ‡$P < 0.05$ vs. SES (ANOVA). §$P < 0.001$ vs. diabetes (ANOVA). ‖$P < 0.01$ vs. SES (ANOVA).

Table 6—*Age-adjusted metabolic variables by SES*

	Diabetes			No diabetes		
	SES			SES		
	Low	Medium	High	Low	Medium	High
n	49	12	2	484	102	34
Total cholesterol (mmol/l)	5.52 ± 0.93	6.00 ± 1.12	5.36 ± 1.19	5.25 ± 1.00	5.47 ± 1.04	5.49 ± 1.15
Triglycerides (mmol/l)	2.4 ± 1.34	1.9 ± 0.72	1.6 ± 0.85	1.7 ± 0.93*	1.6 ± 0.69	1.5 ± 0.93
HDL cholesterol (mmol/l)	1.03 ± 0.30	1.18 ± 0.30	1.29 ± 0	1.13 ± 0.30†	1.19 ± 0.36	1.15 ± 0.31
LDL cholesterol (mmol/l)	3.63 ± 0.74	4.13 ± 0.96	3.54 ± 0.86	3.50 ± 0.90	3.70 ± 0.96	3.78 ± 1.05‡
LDL cholesterol/HDL cholesterol	4.12 ± 3.3	3.62 ± 0.77	2.74 ± 0.68	3.29 ± 1.2*	3.32 ± 1.03	3.64 ± 1.7
Glucose (mmol/l)	8.78 ± 4.17	8.54 ± 4.27	10.4 ± 6.11	5.03 ± 0.44	5.03 ± 0.44	5.02 ± 0.39
Insulin (μU/ml)	11.2 ± 6.7	13.7 ± 11.8	14.1 ± 1.98	10.9 ± 7.3	9.6 ± 7.1	10.3 ± 7.3
Lipoprotein(a) (mg/dl)	15.4 ± 27.8	20.7 ± 23.2	44.1 ± 52.6	16.1 ± 24.1	20.9 ± 31.4	19.9 ± 29.6

Data are means ± SD. **P* < 0.001 vs. diabetes (ANOVA). †*P* < 0.05 vs. diabetes (ANOVA). ‡*P* < 0.05 vs. SES (ANOVA).

poalphalipoproteinemia in 38 and 52% vs. 31 and 42% (*P* = NS). Tables 5 and 6 show the physiological, anthropometric, and metabolic variables in diabetic and nondiabetic individuals separated by SES. In nondiabetic individuals, there was a significant trend toward lower WHR (*P* < 0.01) and higher LDL cholesterol values (*P* < 0.05) with increasing SES, whereas in diabetic individuals, BMI increased significantly (*P* < 0.05) with higher SES. There was also a tendency for lower HDL cholesterol and higher triglyceride concentrations in the low-income group but with no statistically significant differences, which was probably related to the small number of diabetic individuals (*n* = 2) in the high-income group. WHR in the low-income group (diabetic and nondiabetic individuals) was higher than in the medium- and high-income subjects (*P* < 0.05, trend analysis), whereas the prevalence of hypercholesterolemia tended to be lower (*P* < 0.01, trend analysis). They also had increased prevalence of hypertrigliceridemia, hypoalphalipoproteinemia, and hypertension when compared with medium- and high-income groups, but the differences did not reach statistical significance.

DISCUSSION— The prevalence of NIDDM varies markedly among populations. This study shows a high prevalence of diabetes (8.7%) in Mexico City. Women were more affected, and the disease strikes a large group of younger individuals. Of note are the facts that SES, climate, lifestyle, and even Indian roots vary widely in the different regions of Mexico; therefore, these results may not be valid for countrywide extrapolation.

Table 7—*Age-specific prevalence of diabetes mellitus*

	Prevalence (%)				
	Age-specific (years)				
Ethnic group	35–44	45–54	55–64	Crude rate	Age-adjusted rate (%)
Mexican-American (San Antonio, TX)					
M	9/119 (7.6)	24/121 (19.8)	43/150 (28.7)	76/390 (19.5)	17.8
F	29/222 (13.1)	56/235 (23.8)	85/239 (35.6)	170/696 (24.4)	23.0
Low-income barrio (Mexico City)					
M	8/134 (6.0)	11/92 (12.0)	10/48 (20.8)	29/274 (10.6)	12.3
F	10/185 (5.4)	20/116 (17.2)	24/64 (37.5)	54/365 (14.8)	18.5
Mexican (Mexico City); this study					
M	5/98 (5.1)	6/74 (8.1)	10/33 (30.3)	21/205 (10.2)	11.0
F	91/140 (6.4)	9/53 (17.0)	12/35 (34.3)	30/228 (13.2)	15.7

Data are diabetic subjects/total subjects (%). Values for Mexican-Americans and the low-income barrio are from Stern et al. (6).

Age-standardized global estimates of diabetes prevalence in the 20- to 74-year age range have been published recently (1). Data from Mexican-Americans in San Antonio, TX, Mexicans from a low income neighborhood in Mexico City, and the results of this study are presented in Table 7. The prevalence we found is comparatively lower than that observed in Mexican-Americans but very similar to that previously obtained from a poor neighborhood in Mexico City (6).

Studies of migrant populations (17) are widely used to assess the influence of environmental factors on disease while controlling in part for genetic variability. Of great concern is to notice how changes in physical environment and lifestyle, such as those that have occurred in Mexican-Americans, can result in major causes of morbidity and mortality (18,19) and even override genetic susceptibility in the expression of NIDDM and other traits (6,20). Unfortunately, as is demonstrated by this study, the conditions that predispose to an increased prevalence of NIDDM and related complications are already present in Mexico City.

The thrifty genotype hypothesis invokes the proposal that, in traditional populations subject to periods of feast and famine, a survival advantage was conferred on those whose metabolism stored energy with a maximum efficiency (21). With modernization and the accompanying assured supply of highly refined calories, coupled with a sedentary lifestyle, the thrifty genotype became disadvantageous, leading to obesity, hyperinsulinemia, and insulin resistance and eventually to pancreatic β-cell decompensation and NIDDM (19). This seems to occur in the Mexican population, where the genotype probably has a high prevalence and penetration. Interesting to note is that we found an almost similar prevalence of NIDDM in the low- and medium-income classes. This probably explains why we determined a prevalence similar to those previously published from a poor neighborhood in Mexico City (6). The lower prevalence in the high-income group could bring into question the ascending limb hypothesis. We believe this finding is most likely secondary to differences in genetic admixture (more Spaniard than indigenous roots) in the high-income class and further stresses the relevance of genetics in the increased prevalence of NIDDM in our population. In support of the ascending limb hypothesis, there are studies that confirm a rural-urban gradient in the Mexican population (13,14) and an increased prevalence of the disease during the course of the last two decades (15). Poverty in diabetic individuals was associated with increased BMI and with a tendency for higher triglycerides and lower HDL cholesterol values. In nondiabetic individuals, those in the high-income group had a lower WHR and increased LDL cholesterol with a tendency for lower triglyceride levels.

The sampled population, with a mean age of 40 ± 13 years for men and 42 ± 12 years for women, had a high prevalence of hypertension, dyslipidemias, and obesity as shown previously in other studies in the Mexican population (11,22). Our sample of individuals was stratified based on The National Population Census. This probably explains some differences, such as the lower BMI indexes and plasma triglyceride values, when our data were compared with those of a poorer neighborhood in Mexico City, where there is an increased consumption of carbohydrates (6).

An increased prevalence of NIDDM was associated with the highest tertile of BMI and WHR, as described previously. Many studies show that diabetic individuals are at greater risk than nondiabetic individuals for morbidity and mortality because of coronary artery disease. At this time, there is a relatively low prevalence of coronary artery disease in Mexico and in Mexican-American communities (7), despite the high rates of diabetes and the presence of microvascular complications. This apparent paradox has been noted in other populations and is probably part of the natural history of the medical effects of acculturation, in that, whereas diabetes emerges in a relatively short time, the development of atherosclerosis takes much longer (19). It is clear from this study that the anthropometric and metabolic variables present in the Mexican population and particularly in diabetic individuals confer a very high risk for coronary heart disease (23–26) and are likely to be manifested in the next decades. The possibility of a protective genetic factor in our population that may be present in the vascular endothelium, at the level of lipid transport, or by the presence of natural antioxidants or others cannot be excluded but has not been proved. Independently between populations, the coronary risk factors have a similar predictive value.

To conclude, there is a high prevalence of NIDDM in Mexico City that strikes a significant group of younger individuals. Associated coronary risk factors are also common and more prevalent in diabetic individuals. Current epidemiological data in Mexico and in Mexican-Americans in the U.S. suggest that we are in the ascending limb for diabetes and cardiovascular disease. There is a critical need for resources to be allocated to programs for primary and secondary prevention, which must be well structured and organized so that proper standards of care are followed to prevent progression of the disease.

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