Type 2 Diabetes and Metabolic Syndrome in Filipina-American Women

A high-risk nonobese population

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OBJECTIVE — To compare the prevalence of type 2 diabetes and features of the metabolic syndrome among Filipina and Caucasian women in San Diego County, California.

RESEARCH DESIGN AND METHODS — Data on several chronic diseases were collected between 1992 and 1999 from community-dwelling Filipina (n = 294) and Caucasian (n = 379) women aged 50–69 years.

RESULTS — Filipina and Caucasian women did not differ in mean age (59.7 vs. 60 years, respectively), BMI (25.6 vs. 25.4 kg/m^2), percentage of body fat (33.5 vs. 34.2%), or waist-to-hip ratio (0.84 vs. 0.83), although Filipinas had larger waist circumferences and higher percentages of truncal fat. Compared with Caucasians, Filipinas were less likely to be obese (BMI ≥ 30 kg/m^2, 8.8 vs. 14%, P = 0.04) and less likely to smoke, consume alcohol, or take postmenopausal estrogen; Filipinas also had lower levels of HDL cholesterol. Compared with Caucasians, Filipinas had higher prevalence of type 2 diabetes by oral glucose tolerance test criteria (36 vs. 9%) and the metabolic syndrome (34 vs. 13%). These differences persisted after adjusting for age, body size, fat distribution, percentage of body fat, smoking, alcohol consumption, exercise, and estrogen therapy.

CONCLUSIONS — A total of 10% of Filipinas with diabetes were obese, compared with one third of Caucasians with diabetes. The finding of a high prevalence of diabetes in an unstudied nonobese ethnic group reinforces the importance of expanding the study of diabetes to diverse populations. The high prevalence of diabetes in populations who are not of Northern European ancestry may be missed when they are not obese by Western standards.

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Compared with Caucasians, the risk of type 2 diabetes in the U.S. is almost twice as high for African-Americans, Latinos, Native Americans, and Native Hawaiians (1–3). Components of the metabolic syndrome, often defined as the concomitant occurrence of hypertension, dyslipidemia, and altered glucose tolerance, are associated with diabetes and cardiovascular disease (4) and may differ in ethnic minorities (5). The increasing incidence of diabetes and the metabolic syndrome and the relationship with increasing adiposity among ethnic minorities have not been fully elucidated (6).

Filipinos comprise the largest and fastest growing Asian population in California (7). However, the prevalence of diabetes and the metabolic syndrome in Filipinos is unknown. Evidence of excess risk comes from studies showing elevated rates of gestational diabetes among Filipina parturients in the U.S. (8). A 1958–1959 study reported higher prevalence of diabetes in Filipinos compared with Caucasians in Hawaii (22 vs. 7%) (9), and 1994 U.S. mortality data indicated that diabetes was the seventh leading cause of death overall but the fourth leading cause of death in women of four ethnic groups: African-American, Native American, Hawaiian, and Filipina (10). Other studies indicate that hypertension, a frequent component of the metabolic syndrome, is more common among Filipina women than other Asians or African-Americans (11,12).

The population of San Diego County (California) includes >120,000 Filipinos (13). We compared data from community-dwelling Filipina and Caucasian women from San Diego County. The objectives of this study were: *1*) to compare the prevalence of diabetes and the metabolic syndrome between Filipinas and Caucasians; *2*) to compare the distribution of anthropometric measures associated with diabetes and the metabolic syndrome by ethnicity; and *3*) to determine whether ethnic differences in the prevalence of diabetes or the metabolic syndrome were explained by differences in behaviors, body size, or fat distribution.

RESEARCH DESIGN AND METHODS

Study population

Filipina women were recruited between October 1995 and February 1999 for a cross-sectional study designed to estimate the prevalence of several chronic diseases. This study population included community-dwelling women aged 50–69 years who were self-identified as Filipina. Most of the Filipina women lived in north San Diego County, primarily Mira Mesa, a middle-class community with a high proportion of Filipino residents. This population was chosen because it is located 10 miles from our research clinic in Rancho

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Abbreviations: AOR, adjusted odds ratio; DEXA, dual-energy X-ray absorptiometry.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

Bernardo, residence of the Caucasian comparison cohort, and because Filipinos are not identified separately in the San Diego census, so random sampling of the entire county was not feasible. Filipinas were recruited with the help of Filipino community leaders and organizations, local Filipino media, and brochures posted in stores, medical clinics, and social service centers that serve Filipino populations. Research staff included bilingual Filipinas who recruited study participants at churches and during Filipino social functions and festivals. Recruitment materials emphasized general health and included tests for osteoporosis and other diseases, in addition to diabetes, to reduce self-selection bias for participants with known diabetes. All recruitment materials and informed consent documents were translated into Tagalog, the primary language of the Philippines.

The comparison group of non-Hispanic Caucasian women (primarily of Northern European descent) were participants in the Rancho Bernardo Heart and Chronic Disease Study (14), a community-based longitudinal study. From May 1992 to January 1995, ~75% of surviving local, noninstitutionalized members of this middle-class cohort participated in the same study of several chronic diseases, including diabetes.

Data collection

Clinical evaluations for Filipina and Caucasian women took place at the University of California, San Diego Rancho Bernardo Research Clinic using the same protocol, clinic facility, and clinic staff. All participants gave written informed consent. Standardized questionnaires were used. The data instrument was not translated into Tagalog but was administered by a Philippine-born, native Tagalog–speaking female nurse and translated when necessary. All participants spoke functional English.

Demographic characteristics, including age, education, occupation, birthplace, marital and employment status, years of U.S. residence, and ethnic identity, were elicited for each group. Cigarette smoking, alcohol use, physical activity, parity, menopausal status, self-reported health and stress, physician-diagnosed diseases, medication history, and family history of diabetes, hypertension, and other selected chronic diseases were determined using structured questionnaires (15). Participants who were using medications (prescription or nonprescription) or nutritional supplements in the month before the clinic visit brought their pills and prescriptions to the clinic to be verified and recorded by a nurse.

Two morning blood pressure readings were recorded with a mercury sphygmomanometer using the Hypertension Detection and Follow up Program protocol (16). Height and weight were measured with participants wearing lightweight clothing but not shoes. Waist circumference was measured at the bending point and at the narrowest point. Hip circumference was measured at the iliac crest and at the largest point. Percentage of total body fat, truncal fat, and leg body fat (mean, right and left leg) was determined by dual-energy X-ray absorptiometry (DEXA; model QDR-2000 X-ray bone densitometers; Hologic, Waltham, MA). BMI, waist-to-hip ratio, and waist-to-height ratio were calculated.

A 75-g oral glucose tolerance test was performed in the morning after a minimum 8-h fast; blood samples were obtained by venipuncture at 0 and 2 h. Plasma glucose was measured by a glucose-oxidase method and insulin was determined by radioimmunoassay in a diabetes research laboratory. Fasting plasma lipids and lipoproteins were measured in a Lipid Research Clinic Centers for Disease Control and Prevention (CDC)-certified research laboratory (17). Total cholesterol and triglyceride levels were measured by enzymatic techniques using an ABA-2000 biochromatic analyzer (Abbott Laboratories, Irving, TX), a high performance cholesterol reagent (no. 236691; Boehringer-Mannheim Diagnostics, Indianapolis, IN), and a triglyceride agent (no. 6097; Abbott Laboratories). HDL cholesterol was measured according to the procedures of the Lipid Research Clinics Manual. LDL cholesterol was calculated using the Friedewald formula (18). The ratio of total cholesterol and HDL cholesterol was computed as a marker of the atherogenic dyslipidemic state of the metabolic syndrome.

Case criteria

Type 2 diabetes was defined using the 1999 World Health Organization criteria (fasting plasma glucose level ≥126 mg/dl, 2-h postchallenge glucose level ≥200 mg/dl, history of diabetes diagnosed by a physician, or treatment with an oral hypoglycemic agent or insulin) (19). Metabolic syndrome was defined as having at least three of the following risk determinants: *1*) waist circumference >88 cm, *2*) triglycerides ≥150 mg/dl, *3*) HDL cholesterol <50 mg/dl, *4*) antihypertensive medication or systolic blood pressure ≥130 mmHg or diastolic pressure ≥85 mmHg, or *5*) fasting glucose ≥110 mg/dl (20).

To reduce possible differential effects of survival, these analyses were limited to women <70 years of age. Also excluded were women who were using insulin (one Filipina) and women for whom plasma glucose values were not available (two Filipinas, one Caucasian). Data on percentage of body fat, truncal fat, and leg fat were not available for 20 Filipina and 24 Caucasian women, and waist circumference measurements were missing for two Filipina women. Data from these women were excluded from analyses using these variables.

Statistical analysis

Data were analyzed using SAS statistical software (version 6.12; SAS Institute, Cary, NC). Student's *t* test was used for continuous variables, and χ^2 test was used for categorical variables. Univariate analysis was conducted to identify putative predictor variables associated with diabetes and the metabolic syndrome. Multivariate regression was performed to adjust for putative confounding variables including age, anthropometric variables, and behavioral factors. Statistical significance was designated at $P < 0.05$ and odds ratios that excluded 1. There was high collinearity among the anthropometric variables, and not all of these markers of obesity could be included in the regression model. To choose among competing models, the preferred logistic regression model was selected, based on the log likelihood ratio.

RESULTS — The 294 Filipina and 379 Caucasian women did not differ significantly by mean age (59.7 and 60.0 years, respectively), marital status (72.6 vs. 79.2% were married, respectively), or college education status (62.4 vs. 64.9% completed some college, respectively). Compared with Caucasian women, Filipinas had higher parity (4.2 vs. 2.5 mean live births) and were significantly less likely to smoke cigarettes (6 vs. 12% cur-

Table 1—*Mean values of metabolic and anthropometric variables in Filipina and Caucasian women aged 50–69 years in San Diego County, California, 1992–1999*

	Filipinas	Caucasians	*P*
N	294	379	
Age (years)	59.7 ± 5.2	60.0 ± 5.5	0.45
Clinical variables			
Systolic blood pressure (mmHg)	136.2 ± 20.9	126.3 ± 19.8	<0.001
Diastolic blood pressure (mmHg)	79.9 ± 10.1	76.6 ± 9.3	<0.001
Triglycerides (mg/dl)	160.3 ± 116.7	125.2 ± 69.0	<0.001
LDL cholesterol (mg/dl)	135.2 ± 36.4	129.7 ± 32.0	0.034
HDL cholesterol (mg/dl)	53.5 ± 13.0	64.0 ± 16.6	<0.001
Total cholesterol/HDL cholesterol	4.4 ± 1.3	3.7 ± 1.1	<0.001
Fasting plasma glucose (mg/dl)	110.1 ± 37.6	94.1 ± 18.8	<0.001
Postchallenge plasma glucose (mg/dl)	187.9 ± 90.5	120.4 ± 55.0	<0.001
Anthropometric variables			
BMI (kg/m^2)	25.6 ± 3.5	25.4 ± 4.6	0.59
Waist circumference (cm)*	81.7 ± 9.3	79.7 ± 11.9	0.02
Hip girth (cm)	97.1 ± 7.3	95.7 ± 11.6	0.06
Waist-to-hip ratio (cm/cm)	0.84 ± 0.06	0.83 ± 0.07	0.12
Waist-to-height ratio (cm/cm)	0.53 ± 0.06	0.49 ± 0.07	<0.001
Current weight (kg)	60.1 ± 9.4	67.4 ± 12.9	<0.001
Height (cm)	153.2 ± 5.9	162.8 ± 6.2	<0.001
Truncal fat (%)†	31.4 ± 5.8	29.8 ± 8.1	0.005
Leg fat (%, mean right and left leg)	37.3 ± 6.0	41.4 ± 6.5	<0.001
Body fat (%)†	33.5 ± 5.0	34.2 ± 6.7	0.11

Data are means ± SD. *Waist circumference was not available for two Filipinas; †DEXA values were not available for 20 Filipinas and 24 Caucasians.

rently smoked and 15 vs. 52% had ever smoked, respectively), less likely to drink three or more alcoholic beverages per week (1 vs. 55%, respectively), and less likely to use postmenopausal estrogen (19 vs. 60%). Filipinas were more likely than Caucasians to use antihypertensive medications (35 vs. 16%, respectively). Reported exercise (three or more times per week) was similar by ethnicity (63% in Filipinas vs. 65% in Caucasians).

As shown in Table 1, Filipinas had significantly higher mean levels of fasting and postchallenge plasma glucose, systolic and diastolic blood pressure, triglycerides, LDL cholesterol, total cholesterol: HDL cholesterol ratio, and lower HDL cholesterol levels than Caucasian women. Mean BMI, hip girth, waist-to-hip ratio, and total percentage of body fat were similar, but Filipinas had larger waist circumference (by 2 cm), waist-to-height ratio (by 0.04 cm/cm), and percentage of truncal fat (by 1.6%), were shorter (by 10 cm), and weighed less (by 7.3 kg) than Caucasians. Although mean BMI was similar between Filipinas and Caucasians, Filipina women were less likely to be obese, defined as BMI ≥30 kg/m^2 (8.8 vs. 14.0%, $P = 0.04$), and had significantly lower percentage of leg fat (by 4.1%).

Filipinas had more visceral adipose tissue (by truncal fat and waist girth) after adjusting for total body fat (by DEXA); however, truncal fat and waist girth did not differ by ethnicity when adjusted for BMI (data not shown). Percentage of body fat correlated poorly with waist girth among Caucasians ($r^2 = 0.67$) and less so among Filipinas ($r^2 = 0.57$), whereas BMI correlated well with waist girth ($r^2 = 0.85$ for Caucasians and Filipinas) or truncal fat ($r^2 = 0.75$ for Caucasians; $r^2 = 0.73$ for Filipinas).

As shown in Fig. 1, compared with Caucasian women, Filipinas had a significantly higher prevalence of diabetes (36.4 vs. 8.7%, respectively) and the metabolic syndrome (34.3 vs. 12.9%, respectively). The features of the metabolic syndrome were more common in Filipi-

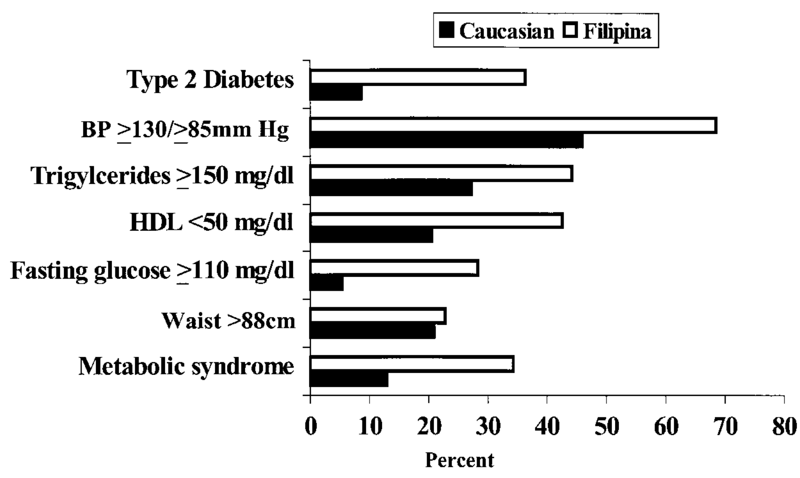

Figure 1—*Prevalence of diabetes, the metabolic syndrome, and its features in Filipina and Caucasian women (aged 50–69 years) in San Diego, California from 1992 to 1999. BP, blood pressure; HDL, HDL cholesterol.*

Table 2—*Covariates associated with diabetes and the metabolic syndrome in Filipina and Caucasian women in San Diego County, California*

	All	Filipinas	Caucasians
n	671	292	379
Diabetes			
Ethnicity (Filipina or Caucasian)	6.12 (3.04–12.3)	—	—
Age (per 5 years)	1.26 (1.02–1.56)	1.16 (0.89–1.49)	1.08 (0.99–1.18)
Truncal fat (%)	1.04 (1.01–1.07)	1.01 (0.98–1.06)	1.05 (1.01–1.09)
Smoker (yes or no)	0.61 (0.26–1.43)	0.28 (0.08–1.05)	1.29 (0.43–3.87)
Alcohol ≥3 times/week (yes or no)	1.56 (0.72–3.39)	2.89 (0.13–58.3)	1.43 (0.62–3.27)
Exercise ≥3 times/week (yes or no)	0.76 (0.49–1.19)	1.00 (0.58–1.73)	0.44 (0.19–1.01)
Use of estrogen (yes or no)	0.93 (0.55–1.59)	0.76 (0.37–1.58)	1.04 (0.45–2.41)
Use of antihypertensive medication	1.70 (1.06–2.71)	1.87 (1.08–3.21)	1.20 (0.44–3.29)
Total cholesterol/HDL cholesterol	1.36 (1.14–1.62)	1.34 (1.09–1.65)	1.38 (0.98–1.95)
Metabolic syndrome			
Ethnicity (Filipina or Caucasian)	2.65 (1.60–4.39)	—	—
Age (per 5 years)	1.18 (0.98–1.41)	0.97 (0.76–1.22)	1.59 (1.17–2.17)
Smoker (yes or no)	1.40 (0.72–2.70)	1.09 (0.40–2.99)	1.43 (0.60–3.45)
Alcohol ≥3 times/week (yes or no)	0.60 (0.33–1.09)	1.38 (0.11–17.3)	0.55 (0.29–1.04)
Exercise ≥3 times/week (yes or no)	0.69 (0.47–1.02)	0.97 (0.58–1.61)	0.48 (0.26–0.89)
Use of estrogen (yes or no)	0.70 (0.45–1.10)	0.37 (0.18–0.77)	1.13 (0.60–2.13)

Data are AOR (95% CI). *Waist circumference was not available for two women.

nas than Caucasians: triglycerides ≥150 mg/dl (44.2 vs. 27.2%, respectively); HDL cholesterol <50 mg/dl (42.5 vs. 20.6%, respectively); antihypertensive medication use or systolic blood pressure ≥130 mmHg or diastolic pressure ≥85 mmHg (68.4 vs. 45.9%, respectively); or fasting glucose ≥110 mg/dl (28.3 vs. 5.3%, respectively). The exception was waist circumference >88 cm (22.7% in Filipinas vs. 20.8% in Caucasians), which was similar by ethnicity. Compared with Caucasians, Filipinas had a sixfold higher prevalence of diabetes (age-adjusted odds ratio [AOR] 6.23) and a more than threefold risk of the metabolic syndrome (AOR 3.58).

Truncal fat was the best body-size marker for diabetes. Filipina ethnicity, older age, higher percentage of truncal fat, use of antihypertensive medication, and elevated total cholesterol:HDL cholesterol ratio were independently associated with diabetes, after adjusting for smoking, alcohol consumption, exercise, and use of estrogen (Table 2). When stratified by ethnicity, truncal fat was the only covariate associated with diabetes in Caucasian women. Among Filipinas, antihypertensive medication and elevated total cholesterol:HDL cholesterol ratios were independently associated with diabetes; truncal fat was not associated with diabetes among Filipinas. However, when waist circumference replaced truncal fat in the regression model, larger waist circumference and total cholesterol:HDL cholesterol ratio were independently associated with diabetes in Filipinas.

In multivariate analysis, being Filipina was the only covariate associated with the metabolic syndrome, after adjusting for age, exercise, smoking, alcohol consumption, and use of estrogen (Table 2). When stratified by ethnicity, not taking estrogen was the only independent predictor of the metabolic syndrome in Filipina women, whereas in Caucasian women, older age and exercising less than three times per week were independently associated with the metabolic syndrome.

The elevated risk of diabetes and the metabolic syndrome in Filipinas compared with Caucasians persisted in analyses excluding smokers (diabetes AOR 6.7 [95% CI 3.2–13.8], metabolic syndrome 2.8 [1.6–4.9]), analyses excluding estrogen users (diabetes 9.7 [2.9–33.1], metabolic syndrome 3.8 [1.7–8.3]), and analyses excluding women using antihypertensive medications (diabetes 5.0 [2.3–10.9]). Other analyses using parity, adult height, or waist-to-height ratio (as a marker for birth weight) did not change the observed ethnic differences. The elevated risk of the metabolic syndrome in Filipinas compared with Caucasians also persisted in analyses excluding diabetic women (2.0, [1.1–3.6]).

Caucasian women with diabetes had significantly more body fat (38.0%) than Filipina women with diabetes (33.3%, $P = 0.005$) and Caucasian women without diabetes (33.9%, $P = 0.01$, Table 3). In Filipinas, however, the percentage of body fat did not differ between women with or without diabetes (33.3 vs. 33.6%, respectively). Similarly, Caucasian women with diabetes had significantly more truncal fat (35%) than Filipinas with diabetes (31.9%) and Caucasian women without diabetes (29.4%), but truncal fat did not differ among Filipina women with or without diabetes (31.9 vs. 31.2%). Mean waist girth was significantly greater in Caucasians with diabetes (92.2 cm) compared with Filipinas with diabetes (84.3 cm). There was a larger difference (13.7 cm) in the mean waist girth between Caucasian diabetics and nondiabetics than between Filipina diabetics and nondiabetics (4.1 cm). There was also a striking difference in categorically defined obesity; 10% of the Filipinas with diabetes had a BMI ≥30 kg/m^2, compared with 33% of the Caucasians with diabetes.

Nearly all of the Filipinas (99%) were born in the Philippines, with a mean age at immigration of 43 years (range 15–68 years) and mean years since immigration of 17 years (0.5–46 years). In regression analysis, neither age at nor years since immigration were associated with risk of diabetes or the metabolic syndrome.

Table 3—*Mean percent body fat, truncal fat, and waist circumference by diabetes diagnosis among Filipina and Caucasian women in San Diego County, California, 1992–1999*

	Filipinas	Caucasians	*P*
N	294	379	
Body fat (%, DEXA)*			
Diabetic	33.3 ± 5.3	38.0 ± 8.1	0.005
Nondiabetic	33.6 ± 4.8	33.9 ± 6.4	0.58
P	0.63	0.01	
Truncal fat (%, DEXA)*			
Diabetic	31.9 ± 6.0	35.7 ± 9.9	0.009
Nondiabetic	31.2 ± 5.7	29.4 ± 8.6	0.018
P	<0.324	<0.001	
Waist circumference (cm)†			
Diabetic	84.3 ± 9.0	92.2 ± 15.4	0.008
Nondiabetic	80.2 ± 9.2	78.5 ± 10.8	0.06
P	<0.001	<0.001	

Data are means ± SD. *DEXA values were not available for 20 Filipina and 24 Caucasian women; †waist circumference was not available for two Filipina women.

CONCLUSIONS — In this study, community-dwelling Filipina-American women had a sixfold higher risk of diabetes and nearly a threefold risk of the metabolic syndrome compared with community-dwelling Caucasian women from the same county. This higher prevalence was not explained by differences in education, parity, body size, fat distribution, percentage of body fat, behaviors, or the use of antihypertensives or hormone replacement therapy.

The prevalence of diabetes in the Rancho Bernardo comparison cohort is similar to the prevalence of diabetes in the U.S. reported by the National Health and Nutrition Examination Survey (1). We could not determine whether our study population is representative of all Filipinas in San Diego County or even Mira Mesa, because Filipinos do not live in a population isolate, and a census-based denominator by Filipino ethnicity is not available. Although the true prevalence of Filipinos in the San Diego population cannot be calculated, sampling bias is an unlikely explanation for the striking excess of diabetes observed here. First, >50% of the Filipina women who fulfilled the case criteria for diabetes were unaware of the diagnosis upon enrollment into the study—similar to the proportion with diagnosed versus undiagnosed diabetes observed in Rancho Bernardo and in the U.S. population (1). Second, these results are compatible with a 50-year-old study showing a threefold higher prevalence of diabetes among Filipinas in Hawaii (9). Third, recruitment materials did not emphasize diabetes but focused on postmenopausal health issues.

Epidemiologic studies of immigrant populations have shown an increased risk of diabetes associated with the adoption of Western diets and lifestyle (1,21), but duration of residence in the U.S. was not associated with prevalence of diabetes in this study. These results differ from studies of immigrants of Japanese descent (1,21) but are similar to observations of Mexican, Puerto Rican, and Cuban immigrants (22). The Philippines, Mexico, Puerto Rico, and Cuba were colonies of Spain for more than three centuries; Puerto Rico and the Philippines became colonies of the U.S. in 1898. Shared cultural factors and exposure to Western lifestyle before immigration or the postmigration homogeneity of lifestyle may explain the absence of an increasing risk of diabetes with increasing duration of residence in the U.S.

The "thrifty gene" hypothesis proposes that chronic or intermittent malnutrition selects survivors who are efficient in energy storage during periods of nutritional insufficiency and leads to obesity during periods of abundance (23). It is believed to contribute to the elevated rates of obesity and diabetes reported among Polynesian and Native American populations (1,24). Filipinos are anthropologically classified as Polynesians, but population genetics and ethnolinguistic studies suggest admixture with Malasian, Austronesian, Indonesian, Chinese, Asian Indian, and Arab populations (25). Shared genetic antecedents to diabetes risk with Polynesians and Latinos may contribute to the high prevalence of diabetes and the metabolic syndrome in Filipinos. However, unlike Polynesian and Latino populations, in which diabetes is associated with adiposity, this Filipina cohort was not obese by Western standards; 90% of the Filipinas with diabetes had a BMI <30 kg/m^2. Therefore, Filipina women resemble Japanese women, in whom risk of diabetes is elevated without a high BMI (21).

These data suggest that there are different optimal BMI levels for different populations. Filipinas with diabetes did, however, have a greater waist girth, similar to observations in Japanese-Americans (26). The propensity for development of central or visceral fat is consistent with higher risk of diabetes and the metabolic syndrome and may be heritable (27). Filipinas may have diabetogenic factors that operate even in nonobese and physically active individuals.

Published studies on adiposity in Filipinas are not available but are essential to comprehend the relationship between visceral adiposity, diabetes, and insulin resistance. Although DEXA measurement of truncal fat provides a more accurate estimate of visceral adiposity compared with waist circumference, truncal fat was not associated with diabetes risk in Filipinas. Waist circumference was independently associated with the features of the metabolic syndrome for each ethnic group. However, truncal fat was associated with each feature of the metabolic syndrome in Caucasians but not in Filipinas.

Infants of low birth weight who become overweight adults are at increased risk for diabetes and the metabolic syndrome (28). Data on birth weight were not available for Filipina women in this cohort, but Filipino infants born in the U.S. have significantly lower birth weight than Caucasian infants (29,30). Filipinas were shorter, compatible with low birth weight (31), but neither height nor waist-to-height ratio explained the higher prevalence of diabetes or the metabolic syndrome, and height was not independently associated with either condition. Multiparity is associated with overweight and possibly diabetes (32). Although Filipinas were multiparous compared with Caucasian women, parity was not associated with risk of diabetes.

In conclusion, the finding of a sixfold higher risk of diabetes in a large, almost unstudied ethnic group in the U.S. reinforces the importance of expanding the study of diabetes to diverse populations who are not of Northern European ancestry, even when they are not obese by Western standards. Studies of differences in prevalence of diabetes and covariates are necessary to understand the etiology and prevention of diabetes and its complications in all ethnic groups.

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