Doug Campos-Outcalt, MD, MPA
Jennifer Ellis, MD
Mikel Aickin, PhD
Jessie Valencia, LPN
Martha Wunsch, MD
Lois Steele, MD

Dr. Campos-Outcalt is Residency Director and Associate Chair, Department of Family and Community Medicine, Maricopa Medical Center, Phoenix, AZ. Dr. Ellis is a General Medical Officer with the Indian Health Service at Cherokee Indian Hospital, Cherokee, NC, and is also completing a preventive medicine residency and obtaining a masters in public health from the University of North Carolina. Dr. Aickin is a Biostatistician and Director of Biometry Consulting for the University of Arizona College of Medicine. Ms. Valencia is a member of the Pascua Yaqui Indian tribe. Dr. Wunsch was the Maternal and Child Health Director for the Pascua Yaqui tribe and is currently in private practice in Boulder, CO. Dr. Steele was the former clinical director at the Pascua Yaqui tribe and is currently in the research program at the Indian Health Service.

Tearsheet requests to Doug Campos-Outcalt, MD, Department of Family and Community Medicine, Maricopa Medical Center, 2601 E. Roosevelt, Phoenix, AZ 85008; tel. 602-267-5426; fax 602-267-5196.

Prevalence of Cardiovascular Disease Risk Factors in a Southwestern Native American Tribe

SYNOPSIS

A CROSS-SECTIONAL study was conducted among the Pascua Yaqui Indian tribe in Tucson, AZ , in 1990 to document the prevalence of cardiovascular disease risk factors. Cardiovascular disease is the leading cause of mortality for Native Americans and for members of the Pascua Yaqui tribe specifically.

A total of 230 randomly selected adults, ages 25–65 years, who were listed as members on the tribal roll, participated, resulting in a 73-percent participation rate for those contacted. The five risk factors studied included diabetes, hypertension, hypercholesterolemia, obesity, and smoking.

Only 14 percent of participants had none of the risk factors; 52 percent had two or more factors. Obesity was the most prevalent, being present in 69 percent of the women and 40 percent of the men, followed by diabetes, 35 percent of men and 39 percent of women. Twenty-six percent of the population had hypertension, and 43 percent of men were smokers, compared with 24 percent of women. Hypercholesterolemia was present in 19 percent of men and 14 percent of women.

The rates of diabetes, obesity, hypertension, and smoking documented in this tribe are relatively high and can serve as a baseline for evaluating future prevention efforts.

Cardiovascular disease (CVD) is the leading cause of mortality for Native Americans and Alaska Natives, although the CVD mortality rate and proportionate mortality are less among these populations than among non-Hispanic whites, Hispanics, and all U.S. races combined (*1–3*).

The importance of CVD in Native Americans may be minimized when proportionate mortality figures are compared with whites, because risks of death from other causes such as accidents and violence are markedly different among the two populations (*1,4*). Other problems involved with comparing Native American-Alaska Native statistics to those of other races include underreporting of CVD, misidentification of Native Americans, and lack of availability of health care services in certain geographic regions. Deaths of Native Americans in New Mexico have been classified as "symptoms and ill defined conditions" more frequently than in other ethnic groups (*2*); such deaths frequently could be due to CVD.

There is a wide range in CVD mortality rates among the different IHS service areas (*5*), and evidence points to increasing CVD mortality in some tribes (*6*). Little is known currently about the prevalence of CVD risk factors, other than diabetes, among specific tribal populations (*7*). Without data on existing traditional CVD risk factors in Native American-Alaska Native populations, it is difficult to assess their importance in causing morbidity and mortality.

Yaqui Indians migrated to Arizona in the early 20th century to avoid persecution by the Mexican Government. They have lived in small communities in or near Tucson, Scottsdale, Guadalupe, and Marana, AZ, ever since. In 1978, the Yaqui tribe obtained official recognition from the U.S. Government, and land was provided for the tribe on the outskirts of Tucson.

A study of the leading causes of death among the Yaqui in the 1979–88 period showed that 22 percent of all deaths were due to CVD; 35 percent among those older than 65 years. In order to document the prevalence of different CVD risk factors and design programs to reduce risk and improve the community CVD profile, a study of CVD risks was conducted in 1990 among this tribe.

Other problems involved with comparing Native American-Alaska Native statistics to those of other races include underreporting of CVD, misidentification of Native Americans, and lack of availability of health care services in certain geographic regions.

Methods

The study took place between February and October 1990. All adults ages 25–65 years who were listed on the official tribal roll and who lived in Pima County (Tucson) were eligible for the study. The goal was to include 250 participants, 10 percent of the tribal adults. A group of 300 potential participants was selected by a computerized table of random numbers. After an attempt to reach each of these participants, another group of 149 was selected using the same method. Because of time and budget limitations, the study was conducted with 230 participants.

After learning about the study and providing informed consent, each participant was interviewed by a trained interviewer fluent in English, Spanish, and Yaqui using a standardized questionnaire. The survey contained questions on (*a*) knowledge and attitudes about CVD and CVD risks, (*b*) current illnesses and medications, (*c*) family history, (*d*) activity levels, (*e*) diet, and (*f*) acculturation and assimilation. Each participant's age was recorded in years.

After answering the questionnaire, each participant was instructed on fasting past midnight and was scheduled for further testing on a Saturday morning. Blood was drawn after the 8-hour fast to measure serum glucose, cholesterol, triglycerides, high density lipoprotein (HDL), and low density lipoprotein (LDL). Those with no current self-reported diagnosis of diabetes were given a 100-gram glucose load, and a repeat blood sample was taken two hours later for a post-prandial serum glucose measurement. All analyses were performed by a local private laboratory.

Fasting glucose, triglyceride, and cholesterol levels were analyzed according to protocol with Olympus AU5000 reagents and chemistry analyzer. Post-prandial glucose was analyzed using Olympus Demand Glucose reagent and chemical chemistry analyzer. HDL was determined by precipitation with the Olympus Demand Analyzer and a modified phosphotungstic acid-MgC1-2 reagent. LDL was calculated using the standard equation [LDL = total cholesterol - HDL - (TRIG ÷ 5)].

Height and weight were measured on the morning of the blood tests. The height of barefoot subjects was measured to the nearest centimeter. Weight was measured on a portable scale to the nearest ounce, with subjects allowed one layer of clothing, and converted to the nearest 0.1 kilogram. Scales were calibrated weekly against clinic scales. Body mass index (BMI) was calculated using the formula, weight in kilograms divided by height in meters squared.

Blood pressure measurements were taken with the cuff width approximately equal to 40 percent of the circumference of the mid-upper arm, the bladder length 80 percent of arm circumference, and the cuff position at least three centimeters proximal to the right antecubital fossa. Two measurements were taken, once after the questionnaire and once after the first blood test, each after the subject had been sitting for five minutes. The two values were averaged. Systolic and diastolic recordings were made at the first and fifth Korotkoff sounds. Blood pressure cuffs and sphygmomanometer were calibrated weekly against a clinic mercury manometer. Each participant was provided with the results of their laboratory tests along with an analysis of their CVD risks and given health education materials on risk reduction.

For our analysis, hypertension is defined according to the 1988 report of the Joint Committee on Detection, Evaluation and Treatment of High Blood Pressure (*8*), as an average diastolic pressure of 90 millimeters of mercury (mm Hg) or greater, a systolic pressure of 140 mm Hg or greater, or taking hypertension medication. Diabetes is defined as fasting serum glucose of 140 milligrams per deciliter (mg

Table 1. Number and percentage of Pascua Yaqui examined by age group and sex compared with totals by age and sex on tribal roll, Tucson, AZ, 1990

	Examined						On tribal rolls					
	Men		Women		Total		Men		Women		Total	
Age group (years)	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
25–34	31	13.5	51	22.2	82	35.7	599	22.9	649	24.3	1,248	46.7
35–44	26	11.3	44	19.1	70	30.4	352	13.2	412	15.4	764	28.6
45–54	14	6.1	34	14.8	48	20.9	167	6.2	227	8.5	394	14.7
55–64	15	6.5	15	6.5	30	13.0	116	4.3	151	5.6	267	10.0
Totals	86	37.4	144	62.6	230	100.0	1,234	46.2	1,439	53.8	2,673	100.0

per dl) or greater, a two-hour post-prandial glucose of 200 mg per dl or greater, or taking diabetes medication (*9,10*). Hypercholesterolemia is defined as cholesterol 240 mg per dl or greater, an LDL of 160 mg per dl or greater, or taking medication to lower cholesterol (*11*); obesity as BMI greater than 30 (*10*).

Statistical analyses were conducted using the Statistical Analysis System (SAS). Mean values, standard deviations, and percent prevalences were defined using descriptive statistics. Means were compared using *t*-tests. Differences among age groups were analyzed with analysis of variance for continuous variables and logistic regression for dichotomous variables. All tests were two-tailed with significance defined as $P < .05$.

Results

The Pima County residents on the Yaqui tribal roll number approximately 5,000 persons. A total of 449 persons were randomly selected for participation in the study; 314 of these were contacted, and 230 completed the study (51 percent of those selected, 73 percent of those contacted).

Table 1 lists the number and percentages of participants by 10-year age and sex groups. Compared with the entire tribal population, women were overrepresented among the respondents (62.6 percent versus 53.8 percent, $P = .006$); men and women ages 25–34 were slightly underrepresented, (35.7 percent versus 46.7 percent), and all those ages 45–54 were overrepresented, (20.9 percent versus 14.7 percent), ($P = .002$).

Table 2 illustrates the prevalence by sex and 10-year age groups of the five CVD risk factors among study participants—diabetes, hypertension, hypercholesterolemia, obesity, and smoking. The prevalence of diabetes increased from 41.5 percent in women in the 35–44 age group to 92.9 percent in those age 55–64. Among men, it increased from 44 percent in the 35–44 age group to 61.5 percent in those ages 55–64. The increasing diabetes prevalence by age, with age treated as a continuous variable, was significant at $P = .0001$; there were no significant male-female differences. The prevalence of hypertension in women increased with age ($P = .0001$) to a level close to 50 percent in the 45–64 age group. There were no significant male, female differences.

Hypercholesterolemia was present in 19.5 percent of the

Table 2. Percentages of diabetes, hypertension, obesity, smoking and hypercholesterolemia by age group and sex among 230 Pascua Yaqui, Tucson, AZ, 1990

Condition	25–34 years	35–44 years	45–54 years	55–64 years	Total
Men:					
Diabetes	10.0	44.0	50.0	61.5	35.4
Hypertension	25.8	23.1	42.9	13.3	25.6
Body mass index greater than 30	43.3	56.0	35.7	7.1	39.8
Smoking	38.7	46.2	35.7	53.3	43.0
Hypercholesterolemia	23.3	16.7	14.3	21.4	19.5
Women:					
Diabetes	14.0	41.5	50.0	92.9	38.9
Hypertension	9.8	22.7	47.1	46.7	26.4
Body mass index greater than 30	64.7	63.4	79.4	76.9	69.1
Smoking	19.6	31.8	20.6	20.0	23.6
Hypercholesterolemia	11.8	11.9	20.6	14.3	14.2

Table 3. Mean values and standard deviation (SD) for fasting and post-prandial glucose levels by age group and sex among 230 Pascua, Tucson, AZ, 1990

	25–34 years		35–44 years		45–54 years		55–64 years		Total	
Sex	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Fasting glucose (mg per dl)										
Men	106.3	46.4	160.8	95.4	152.0	79.2	172.1	75.7	141.8	78.2
Women	110.7	51.3	141.0	81.4	165.8	88.0	214.0	117.2	143.6	82.9
Total	109.0	49.3	148.2	86.6	161.7	84.9	193.1	93.5	142.9	81.1
2-hour post-prandial glucose (mg per dl)										
Men	121.9	82.9	182.8	96.6	143.9	75.0	226.6	144.6	158.8	101.3
Women	124.0	59.1	161.1	92.2	212.1	121.5	232.2	95.5	160.4	95.0
Total	123.2	68.4	169.6	93.7	191.2	112.9	228.5	126.7	159.8	97.3

NOTE: mg per dl = milligrams per deciliter. Known diabetics not included.

Table 4. Mean values and standard deviations (SD) for systolic and diastolic blood pressure readings of 230 Pascua Yaqui, by age group and sex, Tucson, AZ, 1990

	25–34 years		35–44 years		45–54 years		55–64 years		Total	
Sex	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Systolic (mm Hg)										
Men	122.7	12.3	124.0	16.0	129.0	12.0	134.7	13.2	126.0	14.0
Women	116.6	15.8	121.2	13.1	130.1	20.3	139.3	13.4	122.9	17.5
Total	118.9	14.3	122.2	14.2	129.8	18.2	137.0	13.2	124.0	16.3
Diastolic (mm Hg)										
Men	79.9	10.8	79.0	10.1	76.9	7.2	77.3	8.1	78.9	9.7
Women	73.2	11.1	77.5	10.6	79.3	10.3	79.8	9.0	76.5	10.5
Total	75.8	11.4	78.7	10.4	78.6	9.5	78.6	8.5	77.4	10.2

Table 5. Mean Values and standard deviations (SD) for low-density lipoprotein (LDL) and cholesterol, by age group and sex, among 230 Pascua Yaqui, Tucson, AZ, 1990

	25–34 years		35–44 years		45–54 years		55–64 years		Total	
Sex	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
LDL (mg per dl)										
Men	125.4	32.2	108.9	19.9	103.5	28.3	126.9	30.6	117.5	29.4
Women	111.1	35.5	122.1	29.0	126.0	26.1	107.5	29.8	117.5	31.7
Total	116.3	34.8	117.7	26.9	119.8	28.2	116.4	31.1	117.5	30.1
Cholesterol (mg per dl)										
Men	207.6	43.3	203.1	34.9	190.8	43.0	209.5	35.4	203.7	39.4
Women	191.9	37.5	204.5	42.7	208.0	34.8	197.4	51.2	199.8	40.2
Total	197.8	40.2	204.0	39.8	203.0	37.7	203.5	43.6	201.4	39.8

men and 14.2 percent of the women, and did not differ significantly by age or sex. The prevalence of obesity was 69.1 percent in all age groups for women and was significantly higher among women than men in the age group 45–64 ($P < .01$).

A total of 43 percent of men and 23.6 percent of women reported smoking. Men said they smoked more frequently than women in all age groups, and the difference was statistically significant ($P = .003$).

Tables 3–6 list the mean values, by age and sex, for fasting and post-prandial glucose, systolic and diastolic blood pressure, LDL, cholesterol, and BMI. The mean fasting

Table 6. Mean values and standard deviations (SD) for body mass index by age group and sex in 230 Pascua Yaqui, Tucson, AZ, 1990

	25–34 years		*35–44 years*		*45–54 years*		*55–64 years*		*Total*	
Sex	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Men	29.2	5.3	29.9	5.3	28.6	6.3	26.8	3.0	28.9	5.2
Women	33.0	7.0	31.6	5.0	34.0	4.9	33.9	7.3	32.9	6.0
Total	31.6	6.6	31.0	5.2	32.5	5.9	30.2	6.5	31.4	6.0

Table 7. Total number of risk factors by age group, 230 Pascua Yaqui Tucson, AZ, 1990

	25–34 years		*35–44 years*		*45–54 years*		*55–64 years*		*Total*	
Number of risk factors[1]	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*	*Number*	*Percent*
0	16	19.5	9	12.9	3	6.3	3	10	31	13.5
1	36	43.9	26	37.1	12	25.0	7	23.3	81	35.2
2	23	28.0	17	24.3	18	37.5	11	36.7	69	30.0
3	6	7.3	14	20.2	10	20.1	8	26.7	38	16.5
4	1	1.2	3	4.3	4	8.3	1	3.3	9	3.9
5	0	0	1	1.4	1	2.1	0	0	2	0.9

[1]Risk factors = diabetes, hypertension, hypercholesterolemia, obesity, and smoking.

glucose level was above the defined diabetic level for both men and women in all age groups except 25–35 years. The differences between men and women fasting glucose levels were not significant overall or in any age group. The mean BMI was greater than 30 in all women's age groups. The mean BMI for men was significantly lower ($P < .01$) than that for women in all but the 36–45 age group ($P = .21$).

Table 7 shows the total number of risk factors per person by age group. Only 13.5 percent of those sampled had no CVD risks, 35.2 percent had one risk, 30 percent had two risks, and 21.3 percent had three or more risks.

Of 73 diabetic participants, 27 (37 percent) were diagnosed during the study. The 35–44-year-olds were least aware of their diagnosis. Of the 27 diabetic participants in this age group, only 13 were aware of their diagnosis before the study. Approximately half (17 of 33) of the hypertensives were diagnosed at the time of the study. Eight of the 14 hypertensive men and 8 of the 19 hypertensive women were aware of their hypertensive status. Eleven of 15 cases of hypercholesterolemia were diagnosed during the study.

Discussion

This study has documented levels of CVD risk factors in one Southwestern Native American tribe. These data can be used for comparison with other tribes that are receiving systematic study of the prevalence of CVD risks (7) and as a baseline to measure trends over time and outcomes of interventions. Because comparison with other populations can be difficult because of differences in study designs, sample size, definitions, and methods of reporting data, data from comparison populations are presented for discussion only and not as a formal statistical analysis.

The most important finding is the prevalence of diabetes in the Yaqui. Although a 100-gm glucose load rather than 75-gm load was used in our study for glucose tolerance testing, prevalence of diabetes among the Yaqui appears to be greater in all age and sex groups compared with Mexican Americans, non-Hispanic whites (*12*), Native Alaskan tribes (*13*), and Zunis (*14*) and is comparable to the prevalence among the Pima Indians (*15*). A decreased prevalence of diabetes in older age groups seen in the Pima males ages 14 and older and hypothesized to be secondary to a decreased incidence in older cohorts and excess mortality of older diabetics is not seen among the Yaqui (*16*). This study is consistent with others in showing a higher prevalence of diabetes in women than men in older age groups (*14,16,17*).

It is commonly believed that obesity in Native Americans was rare at the turn of the century, increased since 1940 to become a common condition by the late 1960s, and is now higher in Native Americans and Alaska Natives than in other U.S. populations (*18–29*). Knowler has found modest increases in the age- and sexspecific mean BMIs over the past 25 years, suggesting that present-day older adults were never as obese as today's younger adults (*30*). The percentage of men with a BMI of more than 30 is greater in the Pima men than the Yaqui men, but Yaqui women have a greater prevalence of obesity after age 45 (*30*). Weight gain tends to worsen all atherogenic risk factors and contributes to HTN, hypercholesterolemia, and diabetes (*31*).

The correlation between obesity and diabetes is well established, but the degree of causation of diabetes by obesity is a matter of controversy (*32*). It has been hypothesized recently that diabetes and obesity may be two manifestations of one metabolic abberation. Knowler found less of an association of diabetes with BMI at older ages, because diabetes leads to weight loss (*30*). To study the relationship of diabetes to BMI, incidence data is preferable to prevalence data because of the effects of weight loss and treatment of diabetes on BMI.

We do not know if BMI is the best indicator of obesity in the Yaquis, because it does not distinguish percentage of lean body mass nor distribution of body fat. In future analysis of our data, we will examine additional Yaqui anthropomorphic measures such as waist to hip ratio and mid-thigh circumference. Studies have shown that Pima Indians generally have at least as high a percentage of body fat as whites with the same BMI (*30*), and it is expected that the same will be true of the Pascua Yaqui.

Mean cholesterol levels in Yaqui men and women were comparable to those of Mexican-Americans (*12*), whites (*12,33*), and blacks (*33*). Total cholesterol levels were slightly higher in young Yaquis and slightly lower in older Yaquis compared with these other groups.

Yaquis had higher mean systolic and diastolic blood pressures than Mexican Americans and non-Hispanic whites from San Antonio, Texas, and whites from Minnesota in all age and sex groups (*12,33*). Mean blood pressures were lower than or similar to Minnesota blacks and Mexican Americans from Laredo, Texas, and HANES I (*33,34*).

> It is commonly believed that obesity in Native Americans was rare at the turn of the century, increased since 1940 to become a common condition by the late 1960s, and is now higher in Native Americans and Alaska Natives than in other U.S. populations.

Yaquis have rates of smoking greater than 50 percent among men ages 35–44 and 55–64. Because cigarette smoking is a causal factor in the development of arterial wall injury (*35*) and increased serum cholesterol (*36*) and the effect of smoking is noncumulative and reversible (*31*), smoking cessation should be a priority among the Yaqui. Future study should examine attitudes toward smoking and knowledge about its health effects so that effective smoking cessation and prevention campaigns can be initiated.

CVD may be increasing among Native Americans and Alaska Natives, and this increase may be due to increasing levels of the standard risk factors over the past several decades (*37*). In contrast to a decrease in most CVD risk factors and decreasing CVD mortality in U.S. whites, the increase in prevalence of CVD risk factors in Native Americans over the past two to three decades could lead to increased CVD mortality in the coming years (*37*).

The findings of several studies support the theory that this increase in risk factors in Native Americans may be due to the increased acculturation of tribes. The Sioux have had greater exposure over time to European-Anglo lifestyles than the Navajo, and they have rates of acute myocardial infarction (MI) higher than the entire U.S. population and three times higher than the Navajo (*38*). In addition, smoking, hypertension, and obesity are significantly more frequent among Sioux patients with acute MI than Navajo patients with acute MI.

In contrast, the unwesternized Tarahumara tribe of Mexico has lower CVD risks (*39*). Plasma cholesterol levels in the Tarahumara were very low, averaging 136 mg per dl in adults, with only 4 percent having total cholesterol levels above 180 mg per dl. Hypertension existed in less than three percent of adults, and obesity was extremely rare. Of interest is the Tarahumaras' diet with corn and beans making up 90 percent of the total calories. Total fat intake accounts for 11–12 percent of total calories, with only two percent from saturated fat. In addition, the physical activity levels of the Tarahumaras are remarkably high compared with westernized populations.

Another finding of this study worthy of comment is the high percentage of risks found that were previously undetected. This indicates that CVD risk factor studies based solely on medical records would significantly underestimate risk prevalence.

Future analysis of data from this study will include examinations of types of obesity, activity levels, diet, levels of acculturation and assimilation into Anglo and Mexican-American cultures, and knowledge about CVD risks and complications of diabetes and hypercholesterolemia. We plan to use the knowledge obtained to work in collaboration with the Yaqui Tribal Health Department to design, implement, and evaluate interventions to decrease CVD risk and mortality among the Yaqui.

This work was supported in part by the Centers for Disease Control and Prevention (CDC) grant No. CCR905033 and the Indian Health Service (IHS) Research Program. The views presented represent those of the authors and do not necessarily reflect those of CDC or IHS.

Assisting in the study were Clara Lopez and Cristobal Fimbres, who were responsible for data collection, and Maria Flores, the representative of the Pascua Health Department who provided assistance and ongoing collabo-

ration. The Pascua Yaqui Tribal Council gave permission to publish these results.

References

1. Trends in Indian health, 1990. Indian Health Service, Rockville, MD, 1991.
2. Becker, T. M., Wiggins, C., Key, C. R., and Samet, J. M.: Ischemic heart disease mortality in Hispanics, American Indians, and non-Hispanic Whites in New Mexico, 1958–1982. Circulation 78: 302–309 (1988).
3. Welty, T. K., and Coulehan, J. L.: Cardiovascular disease among American Indians and Alaska Natives. Diabetes Care 16: 277–283 (1993).
4. Gillum, R. F.: Ischemic heart disease mortality in American Indians, United States, 1969–1971 and 1979–1981. Am Heart J 115:1141–1144 (1988).
5. Regional differences in Indian health. Indian Health Service, Rockville, MD, 1990.
6. Klain, M., Coulehan, J. L, Arena, V. C, and Jannett, R.: More frequent diagnosis of acute myocardial infarction among Navajo Indians. Am J Public Health 78: 1351–1352 (1988).
7. Lee, E. T., et al.: The strong heart study: a study of cardiovascular disease in American Indians: design and methods. Am J Epidemiol 132:1141–1155 (1990).
8. The 1988 report of the Joint Committee on Detection, Evaluation and Treatment of High Blood Pressure. Arch Intern Med 148: 1023–1038 (1988).
9. Harris, M. I., et al.: International criteria for the diagnosis of diabetes and impaired glucose tolerance. Diabetes Care 8: 562–567 (1985).
10. Hazuda, H. P., Haffner, S. M., Stern, M. P., and Eifler, C. W.: Effects of acculturation and socioeconomic status on obesity and diabetes in Mexican Americans. The San Antonio Heart Study. Am J Epidemiol 128: 1289–1301 (1988).
11. Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults. Arch Intern Med 148: 36–69 (1988).
12. Mitchell, B. D., et al.: Risk factors of cardiovascular mortality in Mexican-American and non-Hispanic whites: the San Antonio Heart Study. Am J Epidemiol 131: 423–433 (1990).
13. Schraer, C. D., et al.: Prevalence of diabetes mellitus in Alaskan Eskimos, Indians, and Aleuts. Diabetes Care 11: 693–700 (1988).
14. Long, T. P.: The prevalence of clinically treated diabetes among Zuni reservation residents. Am J Public Health 68: 901–902 (1978).
15. Knowler, W. C., Pettitt, D. J., Bennett, P. H., and Williams, R. C.: Diabetes mellitus in the Pima Indians: genetic and evolutionary considerations. Am J Phys Anthropol 62: 107–114 (1983).
16. Knowler, W. C., Bennett, P. H., Hamman, R. F., and Miller, M.: Diabetes incidence and prevalence in Pima Indians: a 19-fold greater incidence than in Rochester, Minnesota. Am J Epidemiol 108: 497–505 (1978).
17. Freeman, W. L., Hosey, G. M., Diehr, P., and Gohdes, D.: Diabetes in American Indians of Washington, Oregon, and Idaho. Diabetes Care 12: 282–288 (1988).
18. Broussard, B. A., et al.: Prevalence of obesity in American Indians and Alaska Natives. Am J Clin Nutr 53: 1535–1542~ (1991).
19. Jackson, M. Y.: Nutrition in American Indian health: past, present, and future. J Am Diet Assoc 86: 1561–1565 (1986).
20. Hrdlicka, A.: Physiological and medical observations among the Indians of southwestern United States and northern Mexico. Bull 34, Bureau of Ethnology, Smithsonian Institution, Washington, DC, 1908.
21. Sievers, M. L., and Fisher, J. R.: Diseases of North American Indians. *In* Biocultural aspects of disease, edited by H. R. Rothschild. Academic Press, New York, 1981, pp. 191–252.
22. Mayberry, R. H., and Lindeman, R. D.: A survey of chronic disease and diet in Seminole Indians in Oklahoma. Am J Clin Nutr 13: 127–134 (1963).
23. Stern, J. H., et al.: The high prevalence of abnormal glucose tolerance in the Cherokee Indians of North Carolina. Arch Intern Med 116: 842–845 (1965).
24. Henry, R. E., Burch, T. A., Bennett, P. H., and Miller, M.: Diabetes in the Cocopah Indians. Diabetes 18: 33–37 (1969).
25. Westfall, D. N., and Rosenbloom, A. L.: Diabetes mellitus among the Florida Seminoles. HSMHA Health Rep 86: 1037–1041, November 1971.
26. Sugarman, J., and Percy, C.: Prevalence of diabetes in a Navajo Indian community. Am J Public Health 79: 511–513 (1989).
27. Story, M., Tompkins, R. A., Bass, M. A., and Wakefield, L. M.: Anthropometric measurements and dietary intakes of Cherokee Indian teenagers in North Carolina. J Am Diet Assoc 86: 1555–1560 (1986).
28. Terry, R. D., and Bass, M. A.: Obesity among Eastern Cherokee Indian women: prevalence, self-perceptions, and experiences. Ecol Food Nutr 14: 117–127 (1984).
29. Wolfe, W. S., and Sanjur, D.: Contemporary diet and body weight of Navajo women receiving food assistance: an ethnographic and nutritional investigation. J Am Diet Assoc 88: 822–827 (1988).
30. Knowler, W. C., Pettitt, D. J., Saad, M. F., and Charles, M. A.: Obesity in the Pima Indians: its magnitude and relationship with diabetes. Am J Clin Nutr 53: 15435–15515 (1991).
31. Kannel, W. B.: New perspective on cardiovascular risk factors. Am Heart J 114: 213–219 (1987).
32. Zimmet, P. Z.: Challenges in diabetes epidemiology—from west to the rest. Kelly West Lecture, 1991. Diabetes Care 15: 232–252 (1992).
33. Sprafka, J. M., et al.: Continued decline in cardiovascular disease risk factors: results of the Minnesota Heart Survey, 1980–1982 and 1985–1987. Am J Eidemiol 132: 489–500 (1990).
34. Stern, M. P., et al.: Cardiovascular risk factors in Mexican-Americans in Laredo, Texas. II. Prevalence and control of hypertension. Am J Epidemiol 113: 556–562 (1981).
35. Mustard, J. F.: Cigarette smoking, atherosclerosis and its clinical complications. Can J Public Health 72: 385–388 (1981).
36. Muscat, J. E., Harris, R. E., Haley, N. J., and Wynder, E. L.: Cigarette smoking and plasma cholesterol. Am Heart J 121: 141–147 (1991).
37. Gillum, R. F., Gillum, B. S., and Smith, N.: Cardiovascular risk factors among urban American Indians: blood pressure, serum lipids, smoking, diabetes mellitus, health knowledge and behavior. Am Heart J 107: 765–776, April 1984.
38. Hrabovsky, S. L., Welty, T. K., and Coulehan, J. L.: Acute MI and sudden death in Sioux Indians. West J Med 150: 420–422 (1989).
39. Conner, W. E., et al.: The plasma lipids, lipoproteins, and diet of the Tarahumara Indians of Mexico. Am J Clin Nutr 31: 1131–1142 (1978).