

The Traditional Pima Indian Diet

Composition and adaptation for use in a dietary intervention study

VICKY L. BOYCE, MS, RD
BOYD A. SWINBURN, MB, CHB, FRACP

OBJECTIVE— To examine changes in the Pima Indian diet composition that may have played a role in the dramatic rise in the incidence of NIDDM among Pima Indians over the last century.

RESEARCH DESIGN AND METHODS— We investigated the composition of the foods comparable to those available to the Pima ~100 yr ago, with the aim of reproducing this traditional diet as faithfully as possible for a dietary intervention study. An approximation of the traditional diet was ascertained from the ethnohistoric literature and traditional recipes.

RESULTS— We estimated that the traditional Pima diet, although seasonably variable, was ~70–80% carbohydrate, 8–12% fat, and 12–18% protein. A diet analogous to the traditional Pima diet is largely reproducible with the foods available today. Many native foods are available locally and many commercial products can be substituted when native foods are unavailable.

CONCLUSIONS— The Pima Indian diet of the last century was much higher in carbohydrate and lower in fat compared with the modern-day Pima diet. Any changes that this diabetes-prone population can make toward their traditional diet may help to decrease their incidence of diabetes.

N IDDM in the Pima Indians now has a prevalence of ~50% in adults >35 yr of age (1). However, before the turn of this century, the disease was virtually nonexistent (2,3). Although Pima Indians are probably genetically predisposed to NIDDM, the expression

of the genotype is influenced by environmental factors (4). Diet is undoubtedly one of the most important environmental factors, and indeed dietary patterns among the Pima have changed over the past 100 yr (5).

We investigated the composition

of the Pima diet of 100 yr ago compared with more recent diet compositions and adapted this traditional diet for use in a dietary intervention study.

CHANGES IN THE PIMA DIET—

For at least 500–1000 yr, the Pima lived in the Sonoran Desert as farmers, hunters, and gatherers. An intricate canal system allowed cultivation of crops such as wheat, maize, beans, and squash (6). Hunting of mule deer, jackrabbits, and birds (7), fishing from the Gila River (8), and gathering foods from the desert (such as saguaro cactus fruit, mesquite beans, cholla cactus buds, prickly pear fruit, wild berries, and wild greens) also contributed substantially to their diet.

As the area became more settled in the 1880s, the upstream waters of the Gila River were diverted to such an extent that farming in the desert was no longer possible for the Pima. They became more reliant on other sources of food (such as trading posts and government food programs) and eventually very little food came from subsistence farming, hunting, or gathering (9,10). By the 1950s, Hesse (9) reported a dietary composition of 61% carbohydrate, 24% fat, and 15% protein. Reid et al. (10) reported in 1971 that Pima Indian women consumed a diet that was 44% carbohydrate, 44% fat, and 12% protein. Preliminary data from a dietary survey conducted on the Gila River Reservation in 1989 shows that the current diet was ~47% carbohydrate, 35% fat, 15% protein, and 3% alcohol (C. Smith, unpublished observations).

DEVELOPMENT OF THE STUDY

DIET— A reasonable estimate of the dietary composition of 100 yr ago would be that the calories were 70–80% from carbohydrate, 12–18% from fat, and ~12–18% from protein. Many of the carbohydrates were high in fiber, with low glycemic indices (11). For the dietary intervention trial, a diet (study diet)

.....
FROM THE CLINICAL DIABETES AND NUTRITION SECTION, NATIONAL INSTITUTE OF DIABETES AND DIGESTIVE AND KIDNEY DISEASES, NATIONAL INSTITUTES OF HEALTH, PHOENIX, ARIZONA.

ADDRESS CORRESPONDENCE AND REPRINT REQUESTS TO BOYD SWINBURN, FRACP, UNIVERSITY OF AUCKLAND, SCHOOL OF MEDICINE, DEPARTMENT OF COMMUNITY HEALTH, PRIVATE BAG, AUCKLAND, NEW ZEALAND.

NIDDM, NON-INSULIN-DEPENDENT DIABETES MELLITUS.

Table 1—Two days' sample menus for the traditional diet

DAY 1	DAY 2
BREAKFAST	BREAKFAST
YELLOW CORNMEAL CEREAL WITH MESQUITE FLOUR AND SKIM MILK	BLUE CORNMEAL CEREAL WITH MESQUITE FLOUR AND SKIM MILK
TEPARY BEANS	PINTO BEANS
WHOLE-WHEAT TOAST	WHOLE-WHEAT TOAST
PINOLE	PINOLE
GRAPE JUICE	ORANGE JUICE
SUNFLOWER SEEDS	SUNFLOWER SEEDS
LUNCH	LUNCH
POSOLE	PASTA E FAGIOLI
SPINACH AND TOMATO	HOMEMADE TORTILLA
HOMEMADE TORTILLA	FRUIT
FRUIT	PUMPKIN SEEDS
PUMPKIN SEEDS	
DINNER	DINNER
SALMON GUMBO	SQUASH/NIXTAMAL CASSEROLE
LIMA BEANS	HOMEMADE TORTILLA
HOMEMADE TORTILLA	FRUIT
FRUIT	APPLE JUICE
ORANGE JUICE	CHIA SEED DRINK
CHIA SEED DRINK	
SNACK	SNACK
TURKEY	LO-CAL CHEESE
WHOLE-WHEAT BREAD	WHOLE-WHEAT BREAD
BLUE POPCORN	BLUE POPCORN
APPLE JUICE	GRAPEFRUIT JUICE
PUMPKIN SEEDS	SUNFLOWER SEEDS
MARGARINE	MARGARINE

was designed to emulate the diet of 100 yr ago. Composition of the study diet was 70% carbohydrate, 15% fat, and 15% protein. Slightly higher fat content was used for this diet to improve palatability.

Seven-day menus were designed to provide variety in the diet and to allow for incorporation of as many native foods as possible. The published literature, recipes from Pima Indian women, and published recipes (12–16) served as resources for adapting recipes and menus to our setting. Traditional foods were purchased from local sources or were donated by Native Seeds/SEARCH (Southwestern Endangered Aridlands Resource Clearinghouse). Native foods that were either unavailable or seasonal were substituted with a similar commercial product.

One of the goals of the diet was to achieve calorie levels for weight maintenance. The mean calorie intake of the subjects was 3120 kcal/day (17) and with 70% of the calories from carbohydrate, the volume of food consumed was quite large. The diet was well accepted by the study subjects. Some of the Pima Indian subjects who were in their late 30s remembered having some of the foods in their childhood, and virtually all these foods are available on or near their reservation.

FOODS USED IN THE

DIET — Maize (*Zea mays*) was used in the form of yellow and blue cornmeal for cooked cereal in the morning; blue and white popcorn for snacks; nixtamal, a lime-treated corn similar in taste and texture to hominy, for stews; and dried,

roasted June corn for stews and gavisva (a rough-ground gruel). Wheat was purchased as raw wheat berries that were then toasted and used whole in posole or ground to a flour and used in a beverage called pinole. Tepary beans (*Phaseolus acutifolius*) were used in stews and as side dishes. Dried cholla buds (*Opuntia*) were used in a traditional dish similar in texture to artichoke hearts. Mesquite (*Prosopis*) pods were crushed in a blender and then sifted through a fine sieve. The resulting flour was used daily as a sweetener in the cereal. Fresh spinach was used in place of the wild greens of the same family. Cushaw squash (*Cucurbita*), a traditional squash, was used in some stews. Commercial rabbit was used in place of jackrabbit. The fish that used to live in the Gila River were not available; thus, a combination of tuna, salmon, and catfish was used. Commercial nopalitos were used in place of cactus pads and were incorporated in several recipes. A mucilaginous beverage was made when water was added to chia seeds (*Salvia*). Table 1 shows 2 days of sample menus. For some foods used in the study diet, there was no published nutritional composition. Therefore these foods were commercially analyzed. Table 2 gives the nutritional composition of those foods.

CONCLUSIONS — The major composition change in the Pima Indian diet over the last century has been that the high complex carbohydrate/high fiber foods have been replaced by high-fat modern foods. This change in the Pima Indian diet parallels the increase in diabetes.

The traditional study diet was compared with a high-fat, modern diet (30% carbohydrate, 50% fat, and 20% protein) in nondiabetic Pima Indians and Caucasians (17). The change from the traditional diet to the modern diet resulted in no change in insulin-mediated glucose disposal. However, a deterioration was measured in glucose-mediated glucose disposal (23%), insulin secretion (9–16%), glucose tolerance (8%), and

Table 2—Nutritional analysis of foods used in the traditional diet (100 g basis)

FOOD NAME	MOISTURE (G)	ENERGY (KCAL)	PROTEIN (G)	FAT (G)	CARBOHYDRATE (G)	FIBER (G)
PRICKLY PEAR FRUIT JUICE	91.8	30.56	0.33	0.2	7.36	0.5
MESQUITE POD FLOUR	7.5	251.4	16.44	1.5	69.24	26.2
TEPARY BEANS, BOILED	77.3	70.86	5.57	0.7	15.57	5.0
MEXICAN JUNE CORN (DRIED)	5.5	362.20	12.19	6.5	74.24	10.5
MEXICAN JUNE CORN (COOKED)	86.2	52.16	2.45	1.0	10.24	1.9
NOPALITO CACTUS PADS	92.9	8.44	1.37	0.4	2.54	2.7
NXTAMAL	87.8	45.48	2.24	0.8	8.93	1.6
WHEAT FLOUR TORTILLA	34.2	246.2	8.82	0.7	53.85	2.7

low-density lipoprotein cholesterol (31%). In addition to the changes in the composition of the calories, the obesity in this population (18) suggests that the quantity of the calories in the diet has also increased substantially over the last 100 yr, and this would further contribute to glucose intolerance.

Foods used before the turn of the century are still available and can be incorporated into the daily diet. It is possible to reproduce the composition of traditional diet reasonably well with traditional foods and some commercially available foods. There are several cookbooks available with recipes using traditional foods (13–16). The traditional diet would be considered a healthy diet by the standards of the American Diabetes Association (19). If the Pima were able to change toward that traditional diet, the devastatingly high incidence of diabetes may begin to decline.

Acknowledgments—We thank Dr. Gary Nabhan, Desert Botanical Garden, Phoenix, AZ, for helpful advice and comments. Native Seeds/SEARCH kindly donated some of the traditional foods for the study diet. Thanks also to those from the Gila River Indian Reservation who helped with traditional recipes.

References

- Knowler WC, Bennett PH, Hammon RH, 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
- Hrdlicka A: *Physiological and Medical Observation Among the Indians of the Southwestern United States and Northern Mexico*. Washington, DC, Smithsonian Institution, Bureau of Indian Ethnology, Bulletin 34, 1908
- Russell F: *The Pima Indians*. Tucson, University of Arizona Press, 1975
- Knowler WC, Pettitt DJ, Lillioja S, Nelson RG: Genetic and environmental factors in the development of diabetes mellitus in Pima Indians. In *Genetic Susceptibility to Environmental Factors—A Challenge for Public Intervention*. Smith U, Eriksson S, Lindgarde F, Eds. Stockholm, Almqvist & Wiksell, 1988, p. 67–74
- Nabhan GP: Food, health, and Native American agriculture. In *Our Sustainable Table*. Clark R, Ed. San Francisco, North Point Press, 1990
- Castetter EF, Bell WH: *Pima and Papago Indian Agriculture*. Albuquerque, NM, University of New Mexico Press, 1980 (reprint of 1942 edition), p. 27–72
- Rea AM: Hunting lexemic categories of the Pima Indians. *The Kiva* 44:113–19, 1979
- Davis GP: The American exploration period 1824–1865. In *Man and Wildlife in Arizona*. Carmony NB, Brown DE, Eds. Scottsdale, AZ, Arizona Game and Fish Department, 1982
- Hesse FG: A dietary study of the Pima Indian. *Am J Clin Nutr* 7:532–37, 1959
- Reid JM, Fullmer SD, Pettigrew KD, Burch TA, Bennett PH, Miller M, Wheden GD: Nutrient intake of Pima Indian women: relationships to diabetes mellitus and gallbladder disease. *Am J Clin Nutr* 24:1281–89, 1971
- Brand DC, Snow BJ, Nabhan GP, Truswell AS: Plasma glucose and insulin response to traditional Pima Indian meals. *Am J Clin Nutr* 51:416–20, 1990
- Smith CJ, Schakel SF, Nelson RG: Selected traditional and contemporary foods currently used by the Pima Indians. *J Am Diet Assoc* 91:338–41, 1991
- Hesse ZG: *Southwestern Indian Recipe Book*. Palmer Lake, AZ, Filter Press, 1973
- Niethammer C: *American Indian Food and Lore*. New York, MacMillan Publishing Company, Collier Books, 1974
- Niethammer C: *The Tumbleweed Gourmet*. Tucson, AZ, University of Arizona Press, 1980
- Kavina JT: *Hopi Cookery*. Tucson, AZ, University of Arizona Press, 1980
- Swinburn BA, Boyce VL, Bergman RN, Howard BV, Bogardus C: Deterioration in carbohydrate metabolism and lipoprotein changes induced by modern, high-fat diet in Pima Indians and Caucasians. *J Clin Endocrinol Metab* 73:156–65, 1991
- Knowler WC, Pettitt DJ, Savage PJ, Bennett PH: Diabetes incidence in Pima Indians: contributions of obesity and parental diabetes. *Am J Epidemiol* 113:144–56, 1981
- American Diabetes Association: Nutritional recommendations and principles for individuals with diabetes mellitus (Abstract). *Diabetes Care* 10:126, 1986