

Nutritional composition of commonly consumed traditional Apache foods in Arizona

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Abstract

Primary objective To provide nutritional composition data for commonly consumed traditional Apache foods to enable an assessment of dietary intake and to evaluate a food-store based intervention aimed at reducing risk of chronic disease.

Methods and procedures Weighed recipes were collected in Apache households on the White Mountain Apache reservation in Arizona. The nutritional composition was calculated using the US Department of Agriculture National Nutrient Database.

Main outcomes and results A total of 47 weighed recipes were collected for 13 traditional Apache dishes; five were breads, five were chicken or meat-based stews, two were tortilla-based dishes and the remaining one was a traditional Indian dumpling. The calculated energy, macronutrient content and micronutrient content of these traditional foods are provided.

Conclusions We have provided for the first time the nutritional composition per 100 g for 13 traditional Apache foods. These data are essential for determining dietary intake and diet-disease associations and for developing and evaluating the effectiveness of a food-store-based intervention in this population.

Keywords: Nutritional composition, traditional foods, Apache, American Indians

Introduction

Obesity and other diet-related chronic diseases are widespread in American Indian (AI) communities. Surveys conducted by the US Indian Health Service in the 1990s report obesity rates of 34% and 40% for American Indian men and women, respectively, and these rates are still increasing (Welty 1991; Broussard et al. 1995; Will et al. 1999; Caballero et al. 2003). Adult prevalence of diabetes in AIs was estimated to be over 50% among certain tribes (Knowler et al. 1990; Story et al. 1999). The rapid increase in obesity and chronic disease has been largely attributed to change in lifestyle, and particularly the worsening diet and decreased physical activity.

Data on dietary quality among adult AIs are limited, although one small study showed that 90% of a population sample had diets that were poor or needed

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improvement in terms of the Healthy Eating Index, which was developed by the US Department of Agriculture to assess the dietary quality by examining conformance to the US dietary guidelines, with very few meeting recommendations for fruits, vegetables and dairy products (Basiotis et al. 1999). Results for the Navajo AI population sample were similar, with additional low levels of micronutrient intakes (Ballew et al. 1997). Overall, adult AI diets appear to be as high as or higher in fat and cholesterol than national average intakes (Ballew et al. 1997; Zephier et al. 1997; Mayer-Davis et al. 2004; Stang et al. 2005).

The diets of most AI populations can be considered to have evolved in three phases: pre-contact, early reservation and current. The pre-contact diet was generally gathered or produced locally. The Apache, also called 'Apacheans' or 'Southern Athabaskans', are descendants of the Athabascans language family (Arizona Department of Commerce 2006; People of the Colorado Plateau 2006). The Apache had reached the American Southwest between 1000 and 1500 AD and were separated into a few small groups by the late 1500s over a vast region from central Arizona to northwestern Texas (People of the Colorado Plateau 2006). Among these small groups there were seven major tribes, two of which live partly on the Colorado Plateau—the Navajo and the Western Apache (People of the Colorado Plateau 2006). Among the Western Apache, there were five subtribal groups including White Mountain Apache and San Carlos Apache tribes residing in the contiguous regions in the eastern and central portions of Arizona. The White Mountain Apache reservation was the only reservation that was established on a part of their homeland—'Fort Apache', which is located in the valley of the White River, the ancestral homeland on the Fort Apache Indian Reservation in the White Mountains of East-central Arizona. 'The White Mountain Apache are the direct descendents of the original tribes that lived in this area' (Inter Tribal Council of Arizona 2003). The San Carlos Apache Indian Reservation is located in east-central Arizona.

Among the Apache, based on ethnographic accounts, the pre-contact diet was based heavily on wild game and fish and locally gathered plants. As the Apache were forcibly settled on reservations and thus unable to maintain traditional 'hunter-gathering', they became reliant on US Government-supplied foods, including flour, sugar, lard, beans and canned meats. A cuisine developed based on the incorporation of these foods into the diet. Finally, with increasing contact, establishment of regular food supplies, and the build-up of nearby non-AI communities, the current diet has developed, which includes foods purchased at supermarkets and fast-food restaurants.

There are strong sentiments and preferences among many of the Apache population for pre-contact and early reservation foods. These are frequently referred to locally as 'traditional foods' or 'Indian foods'. Relatively little is known about the nutritional composition of these foods, yet they comprise a significant proportion of the local diet. In our dietary recalls from 52 Apache men and women, traditional foods comprised 18.7% of total energy and 15.5% of fat intake (Cao 2006). Obtaining accurate nutritional composition data for these foods is necessary for assessing dietary intake and for determining associations between diet and diseases, as well as for developing and evaluating dietary interventions that are relevant to the local population.

From 2003 to 2004, we conducted the Apache Healthy Stores Project. This project is a food-store-based intervention aimed at reducing the risk of obesity and chronic disease, through the promotion of healthy foods and food preparation methods in American Indians living on the White Mountain and San Carlos Apache reservations

in Central Northeastern Arizona. We collected 52 24-h dietary recalls to assess the local diet, to help develop nutrition intervention strategies, and to develop a Quantitative Food Frequency Questionnaire (QFFQ) for program evaluation. The final instrument has 155 foods, including 15 traditional foods.

Although the United States Department of Agriculture (USDA 2005) Food Composition Tables do contain some traditional AI foods, they do not contain the nutritional composition for all the traditional foods that subjects reported and that were listed on the QFFQ developed specifically for this population. Furthermore, the food composition values in the USDA Food Composition Tables are not specific to the Apache population. As it was prohibitive to biochemically analyze every food due to funding constraints, we calculated the nutritional composition of traditional Apache foods using weighed recipes, a standard method that has been extensively reported (Bognar and Piekarski 2000; Hakala et al. 2003).

The aim of this paper is to provide, for the first time, the calculated nutritional composition of traditional foods commonly consumed by the Apache population on the White Mountain reservation in Arizona. Apache residing in San Carlos reservation have a similar environment and the same dietary habits including cooking practice. We describe the collection of the weighed recipes and provide the calculated nutritional composition per 100 g food that was commonly consumed and listed on the QFFQ. These data are currently being used to determine food, nutrient, and food group intakes pre-intervention and post-intervention in the Apache population.

Methods

Setting

The White Mountain Apache reservation is located in the White Mountains of northeast-central Arizona. The tribe has about 12,000 members (Inter Tribal Council of Arizona 2003). It is estimated that over 50% of households have incomes below the poverty level (Arizona Commission of Indian Affairs 2005). The primary sources of income for the reservation are lumber, tourism, and raising livestock. Other major employers include the Indian Health Service and the tribal government. About 1,200 tribal members receive food benefits from the Special Supplemental Nutrition Program for Women, Infants and Children (944 children and 264 women).

Traditional Apache foods

Based on 52 dietary recalls and the pilot QFFQ (Sharma et al. 2007), we identified 13 traditional Apache foods that were commonly consumed by adult Apaches. Apache tortilla and fry bread were the most commonly reported traditional Apache foods. Fifty-eight percent of subjects reported consuming Apache tortillas at least once per day. Fry bread was reportedly consumed at least once per day by 37% of the subjects.

Recipe data collection

To calculate the nutritional composition of the 13 traditional foods listed on the QFFQ for which there was no available nutritional composition data, a graduate student was trained by the first author to collect recipes at White Mountain Reservation in Arizona.

The student attempted to obtain weighed recipes from at least five different households. The field coordinator selected people who she believed would be cooperative and allow the student (XC) into their home for several hours at one time. These subjects and their recipes were thought to be similar to the majority of the population residing on the reservation. The households were called and asked whether they would be willing to assist in making recipes for the project. Appointments were then made with them if they agreed.

Apache female volunteers provided the ingredients to be cooked for the student (XC), who weighed all of them and the final cooked weight of the dish at their homes. Attention was paid to each ingredient the Apache volunteer used or discarded. For an example, oil left in the pan after frying was deducted from the total amount of oil. An average recipe was then calculated for each dish. All food weights were obtained using electronic Salter Aquatronic kitchen scale (Salter Houseware, Ltd, Fairfield, NJ, USA). Individuals were reimbursed for the cost of the ingredients.

All data were entered and analyzed using Nutribase Clinical Nutrition Manager version 5.18 (Cybersoft Inc., Phoenix, AZ, USA). Nutribase Clinical is a computerized dietary database based on the USDA National Nutrient Database for Standard Reference. The nutritional composition of each food collected was calculated by entering the ingredients, edible food weights, and final cooked weight. An average recipe was then calculated per 100 g for each food.

Institutional Review Board approval was obtained by the Johns Hopkins University Committee on Human Research. This study was approved by the tribe through tribal resolutions.

Results

A total of 47 recipes were collected for 13 traditional Apache foods, and the average nutritional composition of each traditional Apache food was calculated (Table I). Of the 13 commonly consumed traditional Apache foods, five were breads, five were chicken or meat-based stews, two were tortilla based dishes and the remaining one was a traditional Indian dumpling. To compare the nutritional composition of these traditional foods with similar recipes collected for the Navajo, we list the nutritional composition of fry bread, tortilla and green chili burrito from the USDA National Nutrient Database for Standard Reference Release 18 (USDA 2005). These are the only foods listed in the USDA database that are similar to the Apache foods and could be compared with our data.

Table II presents each food in terms of its main ingredients and the cooking method. For example, fry bread is a bread usually made of wheat flour mixed with baking powder and salt, is deep fried in lard or oil.

Discussion and conclusions

There are limited nutritional composition data available for traditional foods consumed by the Apache population residing in Arizona. Determination of these traditional foods' nutritional composition is of critical importance for assessing dietary intake because of the significant consumption of them. We have provided a description of each food and the calculated nutritional composition of each food for the Apache population. Such data can be used for determining dietary intake (as food, nutrient,

Table I. Nutritional composition of traditional foods commonly consumed by the Apache.

	Fry bread	Fry bread (Navajo— USDA item) ^a	Tennis bread	Ash bread	Oven bread	Indian dumpling	Apache tortilla	Tortilla (Navajo— USDA item) ^b	Apache corn bread
Number of recipes collected	5		4	4	4	4	3		2
Energy (kcal)	341	330	240	246	244	240	204	237	438
Energy (kJ)	1427	1380	1006	1029	1019	1003	854	993	1831
Protein (g)	7.4	6.7	6.8	7.0	6.6	10.6	5.8	7.3	12.2
Carbohydrate (g)	48.3	48.3	50.7	51.8	49.3	26.5	42.8	49.9	65.9
Fat (g)	12.8	12.2	0.6	0.7	2.1	9.6	0.6	1.0	13.2
Saturated fat (g)	3.7	4.6	0.1	0.1	0.6	3.8	0.1	0.3	2.4
Monounsaturated fat (g)	4.9	4.4	0.1	0.1	0.6	4.1	0.1	0.2	2.7
Polyunsaturated fat (g)	2.7	1.1	0.3	0.3	0.7	0.5	0.2	0.4	3.2
Omega-3 fatty acid (g)	0.1	n/a	0.0	0.0	0.0	0.1	0.0	n/a	0.0
Omega-6 fatty acid (g)	2.3	n/a	0.3	0.3	0.2	0.5	0.2	n/a	0.2
Cholesterol (mg)	4.2	7.0	n/a	n/a	0.2	26.3	n/a	n/a	46.4
Phytosterol (mg)	28.4	n/a	n/a	n/a	0.0	0.1	n/a	n/a	n/a
Sugars (g)	3.1	2.0	1.1	1.2	1.0	0.8	1.0	2.8	3.4
Total dietary fiber (g)	1.6	n/a	1.8	1.8	1.8	1.0	1.5	2.4	7.0
Thiamin (mg)	0.5	0.4	0.5	0.5	0.4	0.3	0.4	0.4	0.6
Riboflavin (mg)	0.4	0.2	0.3	0.3	0.3	0.3	0.3	0.1	0.3
Niacin (mg)	3.6	4.6	3.9	4.0	2.9	3.9	3.3	4.1	5.3
Pantothenic acid (mg)	0.4	0.2	0.3	0.3	0.2	0.3	0.3	0.2	0.2
Vitamin B-6 (mg)	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.3
Total folate (µg)	93.6	122.0	101.2	103.6	76.8	54.3	86.4	98.0	114.9
Folate, dietary folate equivalent (µg)	147.3	196.0	160.3	164.1	121.5	83.6	137.0	159.0	98.3
Vitamin B-12 (µg)	0.1	0.0	n/a	n/a	0.0	3.2	n/a	n/a	n/a
Vitamin C (mg)	0.3	n/a	n/a	n/a	0.0	5.0	n/a	0.0	19.5
Vitamin A (µg retinol equivalent)	21.0	n/a	n/a	n/a	0.0	15.3	n/a	n/a	67.9
Vitamin D (International Unit)	14.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vitamin E α-tocopherol equivalent (mg)	0.7	n/a	0.0	0.0	0.0	0.0	0.0	n/a	1.3
α-Tocopherol (mg)	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.3

Table I (Continued)

	Fry bread	Fry bread (Navajo— USDA item) ^a	Tennis bread	Ash bread	Oven bread	Indian dumpling	Apache tor- tilla	Tortilla (Navajo— USDA item) ^b	Apache corn bread
Vitamin K (µg)	n/a	0.8	n/a	n/a	n/a	1.0	n/a	0.4	n/a
Calcium (mg)	258.7	57.0	197.9	165.7	231.1	12.1	10.9	70.0	89.7
Iron (mg)	3.1	4.0	3.3	3.4	2.5	2.4	2.6	3.8	2.9
Zinc (mg)	0.6	0.4	0.5	0.5	0.4	1.8	0.4	0.3	2.5
Magnesium (mg)	18.4	18.0	15.9	16.1	12.5	16.1	12.9	19.0	71.6
Copper (mg)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.4
Manganese (mg)	0.4	0.3	0.5	0.5	0.3	0.3	0.4	0.3	0.8
Fluoride (mg)	0.0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.1
Selenium (µg)	21.1	18.6	22.3	22.8	16.9	14.5	19.0	16.6	20.1
Phosphorus (mg)	376	123	323	281	300	93	62	146	371
Potassium (mg)	122	77	71	72	58	147	60	105	534
Sodium (mg)	754	329	687	782	820	450	271	482	796
	Green chili burrito	Burrito (fast food— USDA item) ^c	Chicken stew	Acorn stew	Elk stew	Beef stew	Cabbage stew		
Number of recipes collected	2		5	4	4	3	3		
Energy (kcal)	236	212	80	71	75	69	40		
Energy (kJ)	988	887	336	299	315	288	167		
Protein (g)	11.6	10.7	5.8	5.9	10.1	6.1	4.1		
Carbohydrate (g)	27.0	24.6	9.2	4.4	6.5	5.8	2.7		
Fat (g)	8.5	8.2	2.1	3.2	0.8	2.3	1.5		
Saturated fat (g)	3.6	4.0	0.4	1.0	0.2	0.8	0.6		
Monounsaturated fat (g)	3.0	3.0	0.5	1.5	0.2	0.9	0.6		
Polyunsaturated fat (g)	0.4	0.5	0.4	0.3	0.2	0.1	0.1		
Omega-3 fatty acid (g)	0.1	n/a	0.0	0.0	0.0	0.0	0.0		
Omega-6 fatty acid (g)	0.4	n/a	0.3	0.1	0.1	0.1	0.1		
Cholesterol (mg)	25.2	27.0	16.1	13.0	22.2	13.3	10.6		
Phytosterol (mg)	0.1	n/a	0.3	n/a	1.3	1.2	3.3		
Sugars (g)	0.9	n/a	0.5	0.1	0.7	1.1	0.8		
Total dietary fiber (g)	1.1	n/a	0.4	0.1	0.6	0.7	0.7		
Thiamin (mg)	0.3	0.2	0.1	0.1	0.0	0.1	0.0		
Riboflavin (mg)	0.3	0.4	0.1	0.1	0.0	0.1	0.0		

Table I (Continued)

	Green chili burrito	Burrito (fast food—USDA item) ^c	Chicken stew	Acorn stew	Elk stew	Beef stew	Cabbage stew
Niacin (mg)	3.8	2.5	1.9	1.2	0.4	1.2	0.6
Pantothenic acid (mg)	0.3	0.9	0.2	0.1	0.1	0.2	0.1
Vitamin B-6 (mg)	0.1	0.2	0.1	0.1	0.1	0.2	0.1
Total folate (µg)	58.1	48.0	2.7	10.2	3.9	5.9	13.3
Folate, dietary folate equivalent (µg)	84.2	69.0	0.0	12.2	n/a	n/a	n/a
Vitamin B-12 (µg)	3.2	0.6	3.2	1.4	0.5	2.3	0.4
Vitamin C (mg)	5.6	0.8	1.9	n/a	3.9	7.6	9.9
Vitamin A (µg retinol equivalent)	22.9	12.0	37.5	0.2	140.5	9.5	3.5
Vitamin D (International Unit)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Vitamin E α-tocopherol equivalent (mg)	0.1	n/a	0.0	0.0	0.1	0.0	0.0
α-Tocopherol (mg)	0.0	n/a	0.0	0.0	0.0	0.0	n/a
Vitamin K (µg)	0.1	n/a	0.1	n/a	0.5	0.0	n/a
Calcium (mg)	48.8	43.0	8.9	6.3	7.0	7.8	16.9
Iron (mg)	2.3	2.2	0.5	0.7	1.3	0.7	0.6
Zinc (mg)	1.9	2.2	0.5	1.4	1.1	1.5	1.1
Magnesium (mg)	16.1	30.0	9.5	11.3	16.5	12.1	9.9
Copper (mg)	0.1	0.2	0.1	0.1	0.1	0.1	0.1
Manganese (mg)	0.3	0.4	0.3	0.1	0.1	0.1	0.1
Fluoride (mg)	n/a	n/a	0.0	n/a	0.0	0.0	n/a
Selenium (µg)	11.7	11.9	3.7	1.7	0.1	0.1	1.6
Phosphorus (mg)	117	70	48	53	81	59	38
Potassium (mg)	170	248	76	137	258	255	157
Sodium (mg)	540	555	76	25	47	88	18

^aFrom USDA (2005, NDB No. 35142).

^bFrom USDA (2005, NDB No. 35143).

^cFrom USDA (2005, NDB No: 21067).

n/a, not available.

Table II. Description of commonly consumed traditional Apache foods.

Name of dish	Description
Fry bread	A bread made of wheat flour mixed with baking powder and salt, which is deep fried in lard or oil. It is often used to make Indian Taco or Apache burger, which are wraps of fry bread with beans or hamburger, shredded cheese, lettuce and tomato
Tennis bread	A bread made of wheat flour mixed with baking powder and salt, which is cooked on a 'tennis track' that is put directly over the fire
Ash bread	A bread made of wheat flour mixed with baking powder and salt, which is cooked by directly being buried in the hot ashes
Oven bread	A bread made of wheat flour mixed with baking powder and salt, which is baked in the oven
Indian dumpling	A dish made by wrapping the filling (usually ground beef) into the tortilla-based dough then boiled in water
Apache tortilla	A bread made of wheat flour mixed with baking powder and salt, which is then cooked briefly in a dry flat pan
Apache corn bread	A bread made of wheat flour mixed with freshly ground corn, eggs, baking powder and salt. The dough is then cooked by shallow frying in oil
Green chili burrito	A dish made by wrapping the filling (usually shallow fried ground beef with green chili) into the tortilla
Chicken stew	A typical Apache stew of chicken cooked with rice, vegetables and canned mushroom soup with a very thick consistency
Acorn soup/stew	A thin stew of chopped beef mixed with acorn powder. The beef is usually boiled first then pounded and put back into the stew to be mixed with the acorn powder. Small dumplings (made of flour and without a filling) can be added into the acorn stew
Elk stew	A thick stew with many ingredients such as elk meat, boiled with macaroni, potato and other vegetables. It is a seasonal food on the White Mountain reservation in Arizona
Beef stew	A thick stew with many ingredients such as beef, boiled with potato, onion, and other vegetables
Cabbage stew	A thin stew of pork, boiled with cabbage

and food group intake) and the association between diet and disease, and for guiding nutrition interventions aimed at modifying recipes to improve dietary intake. For example, to reduce high saturated fat intake, vegetable oil could be promoted as a replacement for lard when cooking Apache fry bread. For foods that are fried (not deep fried), the use of a cooking spray would reduce the total amount of fat in the recipe, such as 'fried eggs and potatoes'.

While the most precise method for producing nutrient values of composite foods is to analyze them directly (Greenfield and Southgate 2003), we had neither the time nor the resources to do this and therefore calculated their nutritional composition. Others have found good agreement when comparing weighed recipes with biochemically analyzed values (Boulous et al. 1996; Porrini et al. 1986). Less reliable values were found for vitamins, which were attributed to variations in nutritional composition data and possible nutrient modifications during the cooking process.

For three foods (fry bread, tortilla and burrito), nutritional composition values were available mainly for the Navajo and values were very similar to the data for the Apache, especially the macronutrients. For the remaining 10 items, there were no similar foods in the USDA Database.

There are limitations to our data: the nutritional composition we calculated did not account for some vitamin losses that could have occurred during cooking, and we were limited by time and cost in the number of recipes we collected. However, the availability of these data may enable others to build on this work and also undertake dietary assessment studies in this population at high risk of diet-related diseases.

These data are currently being used to assess dietary intake in the Apache population and for evaluating the impact of a community-based dietary intervention program, Apache Healthy Stores, aimed at reducing the risk of obesity and other diet-related chronic diseases.

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References

- Arizona Commission of Indian Affairs. 2005. Tribal demographics, 28 March 2005. Available online at: <http://www.indianaffairs.state.az.us/tribes/demo.html> (accessed 28 February 2006).
- Arizona Department of Commerce. 2006. Indian community profiles. San Carlos Apache Reservation—community profiles. Available online at: <http://www.azcommerce.com/doclib/COMMUNE/san%20carlos%20apache.pdf> (accessed 30 April 2006).
- Ballew C, White LL, Strauss KF, Benson LJ, Mendlein JM, Mokdad AH. 1997. Intake of nutrients and food sources of nutrients among the Navajo: findings from the Navajo Health and Nutrition Survey. *J Nutr* 127(10 Suppl):2085S–2093S.
- Basiotis PP, Mino M, Rajen A. 1999. The diet quality of American Indians: Evidence from the Continuing Survey of Food Intakes by Individuals. *Nutr Insights* 12.
- Bognar A, Piekarski J. 2000. Guidelines for recipe information and calculation of nutrient composition of prepared foods (dishes). *J Food Compos Anal* 13:391–410.
- Boulous C, Kanellou A, Trichopoulou A, the Foods and Nutrients Working Group. 1996. Computer and chemically determined nutrient content of foods in Greece. *Int J Food Sci Nutr* 47:507–511.
- Broussard BA, Sugarman JR, Bachman-Carter K, Booth K, Stephenson L, Strauss K, Gohdes D. 1995. Toward comprehensive obesity prevention programs in Native American communities. *Obes Res* 3(Suppl):289S–297S.
- Caballero B, Himes JH, Lohman T, Davis SM, Stevens J, Evans M, Going S, Pablo J, for the Pathways Study Research Group. 2003. Body composition and overweight prevalence in 1704 schoolchildren from 7 American Indian communities. *Am J Clin Nutr* 78(2):308–312.
- Cao, X. 2006. Unpublished data. Thesis, Masters of Nutritional Sciences, University of Hawaii, Honolulu, HI, USA.
- Greenfield H, Southgate DAT. 2003. Food composition data production, management, and use. 2nd ed. Rome: Food and Agriculture Organization of The United Nations.
- Hakala P, Knuts L-R, Vuorinen A, Hammar N, Becker W. 2003. Comparison of nutrient intake data calculated on the basis of two different databases. Results and experiences from a Swedish–Finnish study. *Eur J Clin Nutr* 57:1035–1044.
- Inter Tribal Council of Arizona. 2003. White Mountain Apache Tribe. Available online at: http://www.itcaonline.com/tribes_whitemtn.html (accessed 28 February 2006).
- Knowler WC, Pettitt DJ, Saad MF, Bennett PH. 1990. Diabetes mellitus in the Pima Indians: Incidence, risk factors and pathogenesis. *Diab Metabol Rev* 6:1–27.
- Mayer-Davis EJ, Sparks KC, Hirst K, Costacou T, Lovejoy JC, Regensteiner JG, Hoskin MA, Kriska AM, Bray GA. 2004. The diabetes prevention program research group. Dietary intake in the diabetes prevention program cohort: Baseline and 1-year post-randomization. *Ann Epidemiol* 14:763–772.
- People of the Colorado Plateau. 2006. The Western Apache. Available online at: http://www.cpluhna.nau.edu/People/western_apache.htm (accessed 1 March 2006).

- Porrini M, Ciappellano S, Simonetti P, Testolin G. 1986. Chemical composition of Italian cooked dishes. *Int J Vit Nutr Res* 56:263–268.
- Sharma S, Cao X, Gittelsohn J, Ethelbah B, Anliker J, Caballero B. 2007. Dietary intake and development of a food frequency questionnaire to evaluate a nutrition intervention to reduce risk of chronic disease in American Indian populations. *Public Health Nutr* 10(9):948–956.
- Stang J, Zephier EM, Story M, Himes JH, Yeh JL, Welty T, Howard BV. 2005. Dietary intakes of nutrients thought to modify cardiovascular risk from three groups of American Indians: The Strong Heart Dietary Study, Phase II. *J Am Diet Assoc* 105(12):1895–1903.
- Story M, Evans M, Fabsitz RR, Clay TE, Holy Rock B, Broussard B. 1999. The epidemic of obesity in American Indian communities and the need for childhood obesity-prevention programs. *Am J Clin Nutr* 69(4 Suppl):747S–754S.
- United States Department of Agriculture. 2005. USDA National Nutrient Database for Standard Reference Release 18 (USDA NND SR 18). USDA, Nutrient Data Laboratory, Agricultural Research Service. Available online at: <http://www.nal.usda.gov/fnic/foodcomp/Data/SR18/sr18.html> (accessed 8 March 2006).
- Welty TK. 1991. Health implications of obesity in American Indians and Alaska Natives. *Am J Clin Nutr* 53(Suppl):1616S–1620S.
- Will JC, Denny C, Serdula M, Muneta B. 1999. Trends in body weight among American Indians: Findings from a telephone survey, 1985 through 1996. *Am J Public Health* 89(3):395–398.
- Zephier EM, Ballew C, Mokdad A, Mendlein J, Smith C, Yeh JL, Lee E, Welty TK, Howard B. 1997. Intake of nutrients related to cardiovascular disease risk among three groups of American Indians: The Strong Heart Dietary Study. *Prev Med* 26(4):508–515.

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