

TABLE 1  
Comparison of energy intake in United States (U.S.) and in Israel with United States dietary goals

	U.S.*		U.S. dietary goals†	Israel‡	
	1909-1913	1976		1950	1976/77
Total cal	3480	3300	NR§	2610	3043
% Cal					
From: Protein	12	12	12	12.9	12.7
Fat	32	42	30	25.5	33
Carbohydrate					
total	56	46	58	61.6	54
Refined sugar		18	10		10.8

\* Adapted from Page and Friend (3).

† Dietary goals of the United States Senate Select Committee 1977.

‡ Adapted from the statistical abstract of Israel (1978).

§ Current United States dietary goals advocate a reduction in caloric intake, but do not offer any specific figure as a goal for the population in general.

of 8%, may not be sufficient for decreasing mortality due to nutritionally related diseases. However, a larger reduction in the current United States and Israeli energy intakes, (21 and 14%, respectively), to the average level consumed by the Israeli population in 1950, may be sufficient to decrease mortality rates to the low levels that prevailed in 1950.

*Aviva Palgi, Ph.D.*

Fellow in Clinical Nutrition  
Harvard Medical School

Cancer Research Institute  
194 Pilgrim Road  
Boston, Massachusetts 02215

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## Dietary cholesterol and atherosclerosis: the Tarahumara (Flying Feet) Indians

Dear Sir:

The low level of serum cholesterol of the Tarahumara Indians is used extensively in the literature as an example of excellent dietary accomplishment. McGill (1) quotes from studies on the plasma lipids, lipoproteins, and diet of the Tarahumara Indians of Mexico by Connor et al. (2).

The Tarahumara Indians' diet consists primarily of beans, corn, and squash. Their mean male cholesterol level is 136 mg/dl  $\pm$  27. The average daily intake of cholesterol is 71 mg for adult men; for children, a mere 33 mg/day. Total fat intake is 38 g/day for men and 28 g/day for women, providing 11 to 12% of calories from fat of which only 20% is saturated. Eggs contribute about 70% of dietary cholesterol.

Connor et al. (2) state that "the total plasma cholesterol correlated positively with dietary cholesterol intake ( $r = 0.874$ ), emphasizing that *the first time in man* such a correlation has been found." They conclude, mentioning the absence of hypertension, obesity, and the usual age rise of serum cholesterol in adults, "*thus the customary diet of the Tarahumara Indians is adequate in all nutrients, is hypolipidemic, and is presumably antiatherogenic*" (emphasis mine).

The cited benefits of low cholesterol, low-fat diets must be evaluated in the overall life context of adults and children. The nub of the "dietary goals" recommendations is distressingly similar to the nutrition of the Tarahumara Indians. One may read between the

lines that their diet, allowing a high degree of physical activity and freedom from coronary heart disease, might approach the ideal diet for the combatting of "killer diseases" expounded by Senator McGovern's Select Committee on Nutrition.

My interest in good nutrition was piqued, and though no expert on the mores and habits of the Tarahumara Indians, I sought other sources of information about this tribe, about its lifestyle, its life expectancy, and its social customs. I found suitable information in a completely objective article by the editor of the *National Geographic*, W. E. Garrett (3). This article, accompanied by excellent photographs, gives a neutral observer's findings of the Tarahumaras, a tribe among the most primitive Indians left in North America.

During a week's stay at a Jesuit clinic, Garrett learned that "80% of the Tarahumaras die before five of malnutrition or disease" (emphasis mine). Uncertain and reserved in social contact with outsiders, the Tarahumaras live in the shadow of famine despite efforts by Mexico's National Institute of Indian Affairs to improve their lot. They can coax only meager crops from the rocky soil. Though they herd cattle, sheep, and goats and use the manure as fertilizer, they never milk the cows and usually kill animals only for religious feasts."

I believe that the editors of *The American Journal of Clinical Nutrition* should have been provided with this evidence and should have informed its readers that this tribe, which has been quoted as a paragon of nutrition, actually is at the brink of famine and pays a frightful price to keep its plasma cholesterol low. I fear the so-called correlation of its plasma cholesterol value with its dietary cholesterol intake is an expression of the absolute minimum plasma cholesterol may reach before lack of resistance to disease and pathology develop. The low plasma cholesterol values of the Tarahumaras should be considered an aberration of an insufficient diet and not as a norm to be emulated by followers of an unproven hypothesis. The oft reiterated statement that diets which result in a low plasma serum cholesterol will not cause any health damage is again found wanting in one of nature's own experiments.

It certainly speaks poorly for any recommendation to persuade American mothers to

give their children a diet aimed at lowering plasma cholesterol values to levels approaching those of the Tarahumara Indians. To purposely neglect to mention in a scientific article about nutrition the eventual side effects—as in this case of high child mortality—is quite irresponsible, in my opinion. Similarly, a drug manufacturer is required to mention observed adverse effects of a drug. Generally speaking, defective scientific information may lead to false conclusions and costly and predictably unsuccessful experimentation, and contribute to the lack of credibility and disrepute of nutritional research.

Lowering of plasma cholesterol might not be the highly propagandized remedy for the prevention and treatment of atherosclerosis. Different approaches to the solution of the problem of this terrible disease are urgently needed.

#### Addendum

Since this article was written in January 1980, it has been found that recommendations for diets similar to that of the Tarahumara Indians have been widely disseminated. A book on the national bestseller list states that the Pritikin Diet is roughly the equivalent of that of the Tarahumara Indians; 10% protein, 10% fat, and 80% complex carbohydrates. Exceptional athletic feats of some members of the tribe are mentioned as a quasi-testimonial (4).

Also, Blackburn (5) singles out the low total serum cholesterol of the Tarahumaras and calls them "one fascinating 'natural experiment.'" He claims that "the Tarahumaras are almost entirely vegetarian and are among the more active ethnic groups on earth. Also, they are lean and consume considerable amounts of alcohol as fermented corn beer. They do not smoke heavily." They are reported to have one of the lowest high-density lipoprotein values and low high-density lipoprotein/total cholesterol ratios.

Both authors fail to mention the high child mortality and the malnutrition of the tribe (3) in their praise of the Tarahumara Indians' diet.

Kurt A. Oster, M.D.

Adjunct Research Professor  
Department of Biology  
Fairfield University  
Fairfield, Connecticut 06430

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## Reply to letter by Oster

Dear Sir:

Thank you for providing me with the opportunity to respond to the letter on "Dietary cholesterol and atherosclerosis (the Tarahumara Indians)" by Dr. Kurt Oster. Dr. Oster suggests that the low plasma cholesterol concentrations of the Tarahumara Indians as reported by us do not represent the concentrations seen in states of health. He quotes a *National Geographic* article as indicating that the Tarahumara Indians are on the brink of famine and that 80% of the Tarahumaras die before the age of 5 yr of malnutrition or disease. This information is based upon "a week's stay at a Jesuit clinic" by the writer of the article, a Mr. Garrett. Dr. Oster apparently believes that this article, based upon a week of observation of the Tarahumaras, provides good scientific evidence that 1) they are basically a starving people, 2) obviously, they would then have low plasma cholesterol concentrations, and 3) the implied assumption that the Tarahumaran diet, therefore, is not a good one.

Dr. Oster should have read and quoted the wealth of material about the Tarahumara Indians which goes back to the 19th century and which includes information by early explorers, sociologists, anthropologists, nutritionists, and physicians. The Tarahumaras are like many people throughout our globe whose livelihood is derived from subsistence farming and whose medical care is minimal or completely lacking. The life expectancy of such populations, and this may well include over half of the world's current population, usually is about 30 to 40 yr of age from birth. The vicissitudes of life, such as crop failure, which in Western cultures can be countered by our more abundant technological resources, do cause starvation for many. However, our studies were carried out in healthy Tarahumaras as the following illustrative data will indicate.

Although Dr. Oster alludes to one of our studies in the Tarahumaras which dealt with the plasma lipids and lipoproteins, he does not mention our intensive nutritional study which was also published in *The American Journal of Clinical Nutrition* (1). All of our studies were centered around the village of Sisigouchi which is located in a very fertile valley. Corn and beans grow very nicely here and the soil is quite productive. The Tarahumaras whom we studied were healthy individuals and were not starving. We estimated their caloric intake to be quite adequate for their heights and weights: Tarahumara men consumed 2818 cal, women 2252 cal, girls 2362 cal, and boys 2837 cal. These are certainly equivalent intakes to what is recommended for people in the United States. Our nutritionists lived for four summers with the Tarahumara Indians. I and the other physicians in our research group spent considerable time each summer with the Tarahumaras. We purposefully did not perform any studies on individuals whose health was in any question. For example, the physicians in our group all worked in the hospital maintained by the church in Sisigouchi; we did not study any hospitalized or clinic patients. Some of these individuals were ill with tuberculosis and other infectious diseases and were indeed malnourished. We did see some infants with marasmus and diarrhea.

Our conclusion was that the Tarahumara diet was quite adequate nutritionally and, as used by the Tarahumaras, provided good nutrition which sustained their practice of long-distance running and enabled them to maintain a high state of physical endurance. This diet has a low salt content, is low in cholesterol and saturated fat as well as total fat. It is a very high carbohydrate and fiber diet. Our interest in the Tarahumaras arose from the need to examine the diets of differ-