

Relation of certain market foods to raised coronary lesions

Dietary-atherosclerosis study on deceased persons¹

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In this study, lesser atherosclerotic lesions were found to be related to legumes, grains, and vegetables, while higher lesions were related, but to a lesser degree, to beef, milk, and fruit.

The International Atherosclerosis Project (1) and related studies on the relationship of cigarette smoking rate and atherosclerosis (2,3) provided a unique opportunity to attempt an assessment of dietary life styles (eating pattern and nutrient intake) of deceased New Orleans men by interrogating qualified surviving associates.

Previous reports of these dietary-atherosclerosis studies on deceased persons (4,5) suggest that overall number of meals and heavy snacks, frequency of intake of caffeine and alcoholic beverages (4), and cigarette smoking rate for the last 10 years of life (2,3) may be valid factors in the development of atherosclerotic lesions. These studies also have shown that greater intakes of starch, vegetal protein, total carbohydrate, and crude fiber relate to lesser coronary involvement with advanced atherosclerotic lesions, while higher intakes of animal protein and total fat relate to greater degrees of lesion involvement in the coronary arteries. No evidence of statistically significant associations was observed relating percentages of coronary lesion involvement to

intakes of total saturated fatty acids (SFA), total unsaturated fatty acids (USFA), animal fat (exclusive of fish), vegetal fat, total sugars, or cholesterol (5).

Analyses of the "usual" nutrient intake pattern, expressed as nutrient-to-caloric ratios (6), indicated that the intakes of lysine, myristic and oleic acids, fructose, riboflavin, niacin, calcium, and iodine were associated with greater lesion involvement; higher intakes of sodium and thiamin were associated with lesser lesions (7). Although lesion involvement increased with larger contributions from palmitic and stearic acids and decreased with larger caloric contributions from linoleic and arachidonic acids, these associations were not statistically significant (7). Intakes of sucrose, glucose, lactose, and maltose, vitamins A, E, B₆, and B₁₂, ascorbic acid, phosphorus, iron, potassium, magnesium, tryptophan, methionine, cystine, and phenylalanine were not statistically associated with lesion involvement (7).

This dietary study, however, cannot contribute to the development of practical measures for the control of the increasing prevalence of diseases of atherogenic origin unless some effort is made to relate nutrient-atherogenic findings to foods themselves. Such an effort is the purpose of this report.

Materials and methods

CASES. The 253 men in this study were also subjects in the International Atherosclerosis Project (1) and its substudy, the New Orleans cigarette smoking study (2,3). The men ranged from 20 to 60 years of age. They had shared households with their qualifying female respondents for an average of 18 years. Each respondent must have bought, cooked, and served each subject's food except for five workday lunches and one other meal. Protocol confined the study to the subjects' last year of life although most respondents reported little change in eating habits during the period of their association. The questionnaire used had been developed through the cooperation of more than a hundred living couples. The kind of food, frequency of intake, type of cooking, and serving size were defined (4,8).

SOURCE OF ORIGIN. This report utilizes a previously unreported computer program of the International Dietary Information Foundation, Inc. (9), wherein three macronutrients—protein, fat, and carbohydrate—afford the basis for identifying and quantifying each food source. This classification projects a dietary intake pattern of basic foods rather than nutrients. Each dietary food source is reported in grams and is ranked as a primary, secondary, or tertiary percentage of each macronutrient. For example, individual intake of foods such as eggs, milk, and pork drippings would be reported in grams, and, being entities, each would make a 100 percent contribution of all protein, fat, and carbohydrate present. But when these three foods are mixed in scrambled eggs (one large egg, one and one-third tablespoonsful of whole milk, and one-third teaspoonful of pork drippings), the composite food would

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have the following food sources of origin: protein, 6.53 gm. (90 percent) from egg and 0.70 gm. (10 percent) from milk; fat, 6.05 gm. (67 percent) from egg, 2.30 gm. (25 percent) from pork drippings, and 0.70 gm. (8 percent) from milk; carbohydrate, 0.98 gm. (68 percent) from milk and 0.65 gm. (32 percent) from egg. Fifty-nine such food sources are identified (Table 1).

Extensive use of computed recipes made possible identification and quantification of ingredients in mixed foods. Since the program reports only three quantitations per food, errors of omission did occur in a few composite foods such as fruit cake. The mixture of fruits, nuts, flour, eggs, milk, sugar, and molasses resulted in the three highest sources of protein, accounting for only 80 percent of the cake's total protein, 94 percent of its total fat, and 97 percent of its total carbohydrate. To assess errors of this type in each dietary pattern, the program reports total grams of each classified food source and subtracts this amount from the total obtained in the basic dietary intake. In the dietary patterns, which were based on a 28-day food intake, the following is typical of the calculated errors of omission due to methodology: "1.440 grams" protein, "0.000 grams" fat, and "0.79 grams" carbohydrate.

Twenty-nine sources of basic market-foods were present in sufficient quantity to constitute the basis of this report. A few lesser sources like coconut, chocolate, and peanuts were included because of the unusual characteristics of their fats. Irish potatoes were separated from vegetables so that their dietary contribution might

be evaluated separately. In summary, 18 protein, 24 fat, and 17 carbohydrate food sources were considered in the statistical evaluation.

INTERVIEWS. Interviews with each qualified respondent produced a 28-day recall of the "usual" pattern of food consumed by each deceased subject in terms of frequency (minimum, once a month) and amount as approximated by a series of graduated food models (10). Interviews were conducted according to in-house protocol by a research nutritionist on the staff of the Louisiana State Department of Health (11).

METHODS. The methods of collection and evaluation of autopsy specimens have been previously described (12,13). As before, the extent of the intimal surface of the coronary arteries involved with raised lesions (the more advanced type of atherosclerotic lesions) was used as a measure of extent and severity of atherosclerosis. The dietary data were processed using the food source program which was one of 10 programs developed for this study (9). The food sources are part of the 112 quantitated items in the Extended Table of Nutrient Values (ETNV), 90 of which are either nutrients or nutrient groupings (such as total saturated fatty acids, myristic, palmitic, stearic, *known but not listed*, and *unknown* saturated fatty acids), with the balance being moisture, kilocalories, cholesterol, alcohol, caffeine, fiber, ash, and acidity and alkalinity of ash. Various conversion factors were used in the computations. The

Table 1. Food sources of protein, fat, and carbohydrate in the diets of 253 deceased men of New Orleans

protein		fat		carbohydrate	
animal	vegetal	animal	vegetal	animal	vegetal
beef	grain	beef	grain	milk	grain
pork	legume, mature*	refined tallow†	hydrogenated grain†	eggs	legume*
milk	peanut	pork	legume*	shellfish	peanut
poultry	nut and seed	milk	hydrogenated legume*†		nut and seed
egg	vegetable‡	poultry	peanut		vegetable‡
fish	potatoes (Irish)	eggs	hydrogenated peanut†		potatoes (Irish)
shellfish	fruit	fish	nut and seed		fruit
	chocolate	shellfish	hydrogenated seed†		chocolate
	coconut		vegetal		coconut
	alcoholic		fruit		alcoholic
	beverage		chocolate		beverage
	condiment		coconut		carbonated
			hydrogenated		beverage
			coconut†		condiment
			condiment		cane/beet
			palm		sugar
			hydrogenated		other identified
			palm†		sugars

*Exclusive of peanuts.
†Variant of a food source.
‡Exclusive of Irish potatoes.

primary sources of information for these data were the publications and information provided by the U.S. Departments of Agriculture and Health, Education and Welfare, the Food and Agriculture Organization of the United Nations, and the Institute of Nutrition of Central America and Panama. The scientific literature, manufacturers, and individuals involved in research were additional sources of data.

Assessment of the role of individual types of food in atherosclerosis is complicated by the complex nature of most foods. Except for sugar, which is pure sucrose, no single-nutrient food exists among those commonly eaten. Natural foods are multi-nutrient, and most commercial foods are mixtures of natural foods, often accompanied by admixtures of various chemicals. These facts compound an inherently difficult problem.

Various approaches were employed to assess the relationship of marketplace foods to atherosclerotic involvement in the coronary arteries: correlation analyses—both Spearman and Pearson—and analyses of variance techniques (14). In the analyses of variance, the methodological procedure used previously for studying the associations of atherosclerotic lesions, diet life styles, and nutrient intake patterns was repeated, using not nutrient intake but the intake of each separate food

source. In this case, the absolute intake values of the food sources were divided into low, middle, and high tertile groups, with the percentage of lesion involvement in each tertile group evaluated.

Results and discussion

As expected, this statistical procedure reproduced previous results whenever a single food source contained substantial amounts of some nutrient previously identified as being a significant associate of atherosclerotic lesions. On the other hand, the presence of apparently antagonistic nutrients (in terms of atherosclerotic association) in the same food—whether indigenous to that food or due to some customary combination of foods—appeared to squelch and sometimes even reverse the direction of associations previously detected for nutrients. These data offer no way of assessing by-meal intake of foods; hence, the 28-day daily averages afford no opportunity to assess the potential of nutrient interaction.

By every approach used—as presented in Table 2—mature legumes and grains, the principal food sources of both vegetal protein and starch, were outstanding among the statistically significant associates of lower lesion

Table 2. Summary of statistical analyses of the relationship between intake of selected market food sources of protein, fat, and carbohydrate and raised coronary lesions, based on dietary pattern of last year of life of 253 deceased men in New Orleans

food sources of protein, fat, and carbohydrate		summary of the correlation analyses*		summary of the analysis of variance†			F tests for differences among tertile means	linear trends of tertile means
		Spearman	Pearson	low (N = 84)	middle (N = 85)	high (N = 84)		
legume‡ mature (exclusive of peanuts)	P#	-0.306	-0.304	41	32	21	P = -0.001	P ≤ 0.001
	F#	-0.254	-0.223	39	32	23	P = -0.001	P ≤ 0.001
	C#	-0.359	-0.283	42	30	23	P = -0.001	P ≤ 0.001
grain‡	P	-0.241	-0.178	39	29	27	P = -0.01	P ≤ 0.007
	F	-0.221	-0.181	37	31	26	P = -0.01	P ≤ 0.011
	C	-0.278	-0.187	39	32	23	P = -0.001	P ≤ 0.001
pork‡	P	-0.200	-0.178	38	29	27	P = -0.01	P ≤ 0.004
	F	-0.135	-0.123	40	28	27	P = -0.01	P ≤ 0.020
alcoholic beverages¶	P	-0.178	-0.159	37	33	24	P = -0.01	P ≤ 0.013
	C	-0.182	—	36	35	25	P = -0.01	P ≤ 0.005
fruit	F	NS	+0.137	26	31	37	P = +0.01	P ≤ 0.013
	C	NS	+0.145	NS	NS	NS	NS	—
beef	P	NS	+0.156	27	29	39	P = +0.01	P ≤ 0.006
	F	NS	+0.124	24	35	35	P = +0.01	P ≤ 0.008
milk	P	NS	+0.142	26	32	36	P = +0.05	P ≤ 0.018
	C	NS	—	—	—	—	—	—
vegetables (exclusive of Irish potatoes)	P	-0.125	NS	NS	NS	NS	NS	—
	F	-0.145	NS	NS	NS	NS	NS	—
	C	-0.155	NS	NS	NS	NS	NS	—
Potatoes (Irish)	P	-0.155	NS	NS	NS	NS	NS	—
	F	-0.161	NS	NS	NS	NS	NS	—
	C	-0.191	NS	NS	NS	NS	NS	—
poultry	F	-0.181	NS	NS	NS	NS	NS	—

*Correlation coefficients of the intake of selected food sources of major nutrients and raised coronary lesion involvement.

†Mean percentage of raised coronary lesion involvement in terms of intake of tertile groupings of selected food sources of major nutrients.

‡These fats contain only their respective kind, whether originating in single or in composite foods.

#P = protein; F = fat; C = carbohydrate.

¶Mean daily intake of alcohol approximately 1 gm.

||Not significant.

involvement (5). This had been expected from the nutrient assessment. Similar findings have been reported recently in a Puerto Rican study in which there is a striking similarity of dietary pattern—specifically rice and legumes (15). These studies were based on two basically different populations—New Orleans metropolitan area having a high incidence of coronary heart disease and Puerto Rico having a low incidence. The subjects in New Orleans were deceased, and the diagnosis of coronary heart disease was based on autopsy findings, while the Puerto Rican study was based on clinical findings on living subjects.

Pork and poultry contributed “animal protein” and “total fat”—two nutrient groupings that had been statistically significant associates of the higher atherosclerotic involvement of the coronary lesions. As an animal food source, however, only pork protein, pork fat, and poultry fat were indicated to be statistically significant associates of the lesions, but they were associated with lower lesions, not with higher ones, as had been anticipated.

Alcoholic beverages, vegetables, and Irish potatoes, which were considered separately from vegetables, completed the list of food sources statistically associated with lower lesions. Beef, milk, and fruit were associated with higher lesions. Most associations were consistent with those based on nutrient content. Except in the case of mature legumes and grains, the associations were much less impressive.

To New Orleanians and to Puerto Ricans, mature legumes and grains translate at the table into beans and rice. In New Orleans, this dish is nearly always eaten with French bread. It is so popular that Monday is traditionally red beans and rice day in many homes and restaurants. In the methodology-developmental period of this study, nutrient intake for each day of the week was explored; Monday ranked highest in intake of vegetal protein (16,17). In a study on frequency of intake by these men, mature legumes ranked fourth among the 26 foods most frequently consumed and had contributed 40 percent of the vegetal protein (16). Traditionally, pork is the seasoning for red beans. A typical family recipe contained 95 percent bean and 5 percent pork protein, while virtually all the fat came from pork (16). Overall in these diets, beans and other legumes—except peanuts—contributed 45 percent of the total vegetal protein (16).

In addition to its combination with beans and rice, pork fat (lard included) had another common use in New Orleans. Bakers, because of lard's lower cost at the time of the study, almost always used lard for shortening in breads. Breads, according to the frequency and size of serving of the 26 most commonly eaten foods in this study, ranked first in amount and second in frequency (17).

Protein and fat from pork changed their expected direction of association with the lesions. This shift is attributed to the habitual use in small quantities of pork in dried beans and of lard in breads. In nutrient data, pork protein previously had been included along with all

other animal proteins, a grouping which was statistically associated with higher lesions (4). However, pork protein *per se*, which these men almost always ate with beans, now classified as did the legumes and grains. Apparently the presence of small amounts of a food of antagonistic athero-association in a mixture of foods might result in an apparent shift of a previously assessed association. This highlights one of the weaknesses inherent in any situation in which many variables exist but only a few are assessable.

Poultry fat, for these men, was chicken fat, which in these diets was never used alone. Chicken was most often rolled in flour and pan fried in cottonseed or soybean oil. The skillet residue was the base of a gravy customarily served with rice. Chicken with spaghetti was the second most popular chicken dish. Local eating habits thus bring high starch into the picture of dietary consumption of chicken fat. Because individual foods are seldom eaten alone as meals, no irrefutable assessment of the role of any individual food in the etiology of atherosclerosis is possible.

Unlike legumes and grains, which consistently evinced strong negative involvement with raised coronary lesions (5), vegetables and Irish potatoes *per se* show a weak association with lesser raised coronary lesions. These two sources, i.e., vegetables in general and Irish potatoes, contributed much of the total fiber in the diets of these men. The absolute values of total fiber intake have been reported as being associated significantly with lesser raised coronary lesions (5). Whether alcohol in the moderate amounts consumed in these diets was considered alone or in mixtures (alcoholic beverages), its association with raised coronary lesions was negative (16).

Food sources associated with greater involvement of raised coronary lesions were beef, milk, and fruits. All, however, were associates of low statistical order. It is believed that the association of fruit with more extensive involvement with raised coronary lesions could be due to its being the major dietary source of fructose. Fructose had a strong positive association with coronary lesions (7,18,19). The renewed interest in basic carbohydrate research may resolve the logic involved in the associations indicated for starch and fructose—both of which carried over to their principal dietary sources (20).

Two very commonplace foods—eggs and sugar—gave no evidence of any significant association with coronary atherosclerotic lesions in this study, even though egg consumption has often been considered to be associated with serum cholesterol and serum triglyceride levels in humans (21). Fish, while an item in the local diet, contributed a very small part of either protein or fat in these diets. Other foods included in Table 1 also were eaten in relatively small quantities and hence were necessarily omitted from statistical evaluation.

Summary

In an effort to relate foods rather than nutrients to raised coronary lesion involvement determined at autopsy on

253 New Orleans men, a 28-day dietary history on "usual" food intake for the last year of life was studied by classifying food sources of dietary protein, fat, and carbohydrate in the more commonly eaten foods. Because not all of these foods contain all three of the macronutrients under study, the actual number of variables was 59.

Beans (as mature legumes) and grains (mainly as wheat in bread or pasta and rice) related significantly to lesser raised coronary lesions, a finding consistent with an earlier report of the association of coronary lesions with the dietary intake of vegetal protein and starch.

Pork, a seasoning in the traditional mixture of red beans and rice in New Orleans, was found to be statistically related to lesser lesions. This however, may have been the result of the dominant effect of the vegetal food components (vegetal protein and starch) of the very popular local combination of dried beans and rice.

Alcohol in the moderate amounts reported in these diets also was associated statistically with lesser lesion involvement. Vegetables, Irish potatoes, and chicken fat appear weakly associated with lesser atherosclerotic lesions in the coronary arteries.

Foods associated with greater involvement of raised coronary arteries are beef, milk, and fruit, but these associations are of a low order.

Two commonly eaten foods—eggs and sugar—showed no significant association with atherosclerotic lesions. Other foods, perhaps because of low intake or because of unrecognized antagonistic effects which undoubtedly occur in ordinary diets, showed no association with raised coronary lesions.

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