

Follow-Up Study of Serum Cholesterol, Diet and Physical Findings of Italian-American Factory Workers

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VARIOUS investigators have observed that the incidence of atherosclerosis and coronary artery disease is higher in certain areas of the world than in others. The observations of some of these researchers support the hyperlipophagia-hyperlipemia hypothesis of partial causation in these diseases. Keys and co-workers,^{1,2} for example, noted that Neapolitan laborers eat less fat (about 20 per cent of their calories), have lower serum cholesterol levels and have less heart disease than do American laborers whose diet supplies about 40 per cent of their calories from fat. They propose that the advantageous position of the Neapolitan laborers with respect to serum cholesterol level and heart disease is more due to diet than "race," since Neapolitan professional men and Bolognese workers whose diets are richer in fat also have higher levels of serum cholesterol and more coronary artery disease.²

In 1956 Miller et al.³ studied the diet, blood lipids and health of 189 men in Boston who had lived all their adult lives in the United States, but whose parents were born near Naples. They compared the serum cholesterol level and diet of the Neapolitan Bostonians with that of the laborers observed by

Keys¹ in Naples. The subjects were between the ages of twenty and fifty years and were employed by the B. F. Goodrich Footwear and Flooring Company in Watertown, Massachusetts. The study³ indicated that the Bostonians of Italian descent had a mean serum cholesterol level and dietary fat intake similar to other Americans and significantly higher than that of native Neapolitans. In 1958, the participants of the 1956 survey were asked to cooperate in a follow-up study.

METHOD

Complete records were obtained from 147 of the original group of 189. Of the forty-two subjects excluded in the 1958 follow-up study about half (eighteen) were no longer working at the factory; ten were ill, on vacation, or for some other reason were unable to come for their examination as scheduled; and eleven men did not care to participate. Three other subjects were excluded because of incomplete data (the tubes containing serum of two subjects broke and data on smoking were not obtained from the third subject).

The follow-up study included a detailed physical examination, comparable to that given in the first study, and in addition various anthropometric measurements. Laboratory studies included a blood sample for serum cholesterol determination, urine specimen for determination of sugar and albumin, and a twelve-lead electrocardiogram. In 1958, the serum cholesterol level was measured by the micromethod of Carpenter, Gotsis and Hegsted⁴ whereas in 1956 the cholesterol level was determined by the method of Abell et al.⁵

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This study was supported in parts by grants-in-aid from The John A. Hartford Memorial Fund; the Albert and Mary Lasker Foundation, New York; and the Fund for Research and Teaching, Department of Nutrition, Harvard School of Public Health.

TABLE I
Mean Total Cholesterol Concentration and Mean Relative Weight, with Age

Age (yr.) (in 1956)	No.	Total Cholesterol (mg. %)				Relative Weight			
		1956		1958		1956		1958	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
20-29	25	232	41	222	37	107	12	107	12
30-39	59	238	41	232	44	112	13	112	13
40-49	60	247	46	238	49	107	12	106	12
50+	3	258	37	256	58	106	12	103	5
All ages	147	241	43	233	45	109	13	109	12

The results obtained by the micromethod of Carpenter are in good agreement with those obtained with the standard colorimetric method of Abell.

The relative weights of the subjects were computed, using the tables of standard weights for age, sex and height determined from the Medico-Actuarial Investigation of the Metropolitan Life Insurance Company.⁶ This table allows for a moderate increase in weight with age.

Dietary data were collected from a subsample of thirty-nine men (approximately a quarter of the sample) by a Burke-type⁷ research dietary interview. This report will be limited to discussing cholesterol levels, weight, smoking and dietary findings.

RESULTS

The means for serum cholesterol levels and relative weight for age groupings according to decades are presented in Table I. The

TABLE II
Mean Total Cholesterol and Relative Weight with Cigarette Smoking

Packs of Cigarettes (per day)	No.	Cholesterol (mg. %)	Relative Weight
None	36	223*	112*
Less than one	42	231	110
One or more	69	241*	106*
All smokers	111	237	108

* Significant ($p < 0.05$)

mean serum total cholesterol for the entire sample of 147 subjects was 233 mg. per 100 ml. in 1958. This was slightly lower than the mean of 241 mg. per 100 ml. for this group in 1956. As expected, a slight increase with age was noted. No differences in mean relative weight for the group were observed between the two studies.

The relationship of cigarette smoking to blood cholesterol level and relative weight for this follow-up study is shown in Table II. The subjects were divided into three groups: (1) those who did not smoke, (2) those who smoked less than one package of cigarettes a day, and (3) those who smoked one or more packages a day. The mean serum cholesterol level of the men who smoked one or more packages of cigarettes a day was significantly higher ($p < 0.05$) and their mean relative weight

TABLE III
Mean Total Cholesterol and Factors Associated with Atherosclerosis

No. of Subjects	No. of Factors Possibly Associated with Atherosclerosis*	Mean Serum Cholesterol (mg. %)
8	0	213
35	1	232
69	2	236
25	3	243
2	4	242
Total 139†		

* Family history, obesity, smoking and hypertension.

† Incomplete data on eight subjects.

TABLE IV

Comparison of Two Dietary History Interviews of Thirty-Nine Italian-American Subjects at Two Different Periods

	1956		1958		r†	t‡
	Mean	SEx*	Mean	SEx*		
Calories.....	3,507	132	3,367	127	0.59	N.S.§
Protein (gm.).....	133	4.96	135	5.76	0.49	N.S.
Fat (gm.).....	164	6.73	163	6.89	0.43	N.S.
Alcohol (gm.).....	38	6.41	27	4.80	0.52	Significant
% Calories						
Protein.....	14.5	0.37	15.4	0.27	0.25	N.S.
Fat.....	41.0	1.07	43.0	0.95	0.62	N.S.
Alcohol.....	6.9	1.05	5.6	1.00	0.61	N.S.

* Standard error of the mean.

† Correlation coefficient.

‡ Students paired "t."

§ N.S. = Not significant.

was significantly lower ($p < 0.05$) than that of nonsmokers. The differences between the cholesterol level and relative weight of the other groups were not significant. The lower relative weight of smokers could not be accounted for by the food intake they reported. In fact, when the thirty-nine subjects included in the dietary interview group were separated into two categories, i.e., smokers and nonsmokers, the mean calorie intake was 3,607 for the former and 3,270 for the latter. (The difference was not significant.)

The question of whether obesity plays a role in establishing serum cholesterol level certainly is not elucidated by this study. Although the mean cholesterol level of men with a relative weight of 100 per cent or less was lower (220 mg. per 100 ml.) than that of men whose relative weight was 120 per cent or more (231 mg. per 100 ml.), the difference was not significant. On the other hand, the data in Table II show that heavy smokers have a significantly higher serum cholesterol level but significantly lower relative weight than nonsmokers.

Various investigators are of the opinion that certain factors, namely, heredity, high serum cholesterol levels, obesity, smoking and hypertension have a cumulative effect in causation of coronary arterial and heart disease. We found a trend but no significant differences between the level of serum cholesterol and the number

of factors which could be ascribed to the subjects as is shown in Table III. The groups compared, however, were small.

Table IV gives the results of dietary interviews obtained from a subsample of thirty-nine men in 1958 and compares it with data secured from these same persons by the same method in 1956. There were no significant differences except for grams of alcohol. Alcohol consumption may have decreased in 1958 for economic reasons.

No significant dietary changes were observed when the group was considered as a whole, except for grams of alcohol, but considerable individual variations in food intake between the two periods are indicated by the correlation coefficients. In general, the correlation coefficients for the dietary factors were in the neighborhood of 0.4 to 0.6. However, the correlation for the per cent of calories from protein was 0.25, although the mean per cent of calories supplied by protein was approximately 15 for both years (14.6 in 1956 and 15.4 in 1958). This low correlation might be explained in part by the fact that the range for the per cent of calories from protein is narrow; in our sample the range was from 10 to 18.9.

To evaluate the interviews further, the diet records were assessed by a method suggested by Epstein and his associates,⁸ whereby (1) the basal caloric requirement is estimated for each person from the Boothby tables,⁹ (2) an allow-

ance for activity is added to the basal figure, and (3) the calculated intakes are considered acceptable if they fall within 30 per cent of this figure. About two-thirds (twenty-seven) of the subjects' histories were "acceptable" in both 1956 and 1958. And of the thirty-nine men thirty-two fell into the same category, i.e., "acceptable" or "not acceptable" in both studies. Seven men fell into a different category in 1958 than they had in 1956. In three the intake was reported as excessive in 1956 but in the "acceptable" range in 1958. Of these three, one had lost 13 pounds, one 12 pounds and one showed no change in weight. In the remaining four the intake was in the "acceptable" category in 1956 but reported as excessive in 1958. Three of these men gained weight, 7, 6 and 5 pounds, respectively; the other subject had no change in weight. Although the sample is small, it does indicate that these persons tend to stay in their own category, or if they fall into different categories, the changes can be accounted for, in most cases, by weight gain or loss. Whether or not the use of the Boothby-Berkson⁹ chart results in estimates of caloric requirement which are too high is subject to question. The mean percentage of caloric intake in relation to basal metabolic requirement for the 189 subjects interviewed in 1956 was 103 per cent above the basal requirement.³ This may seem excessively high in view of the activity allowance of 50 per cent calories above the basal requirement for moderately active subjects and 60 per cent above the basal requirement for more rigorous workers used by Epstein et al.⁸ However, in a study of Scottish clerks and miners, Garry and co-workers¹⁰ reported an average intake that was 80 per cent above the basal requirement for the former and 147 per cent for the latter.

The results of this small repeat study of the dietary interview indicate that for the group, dietary information collected at one year reflects the general eating pattern for both years. There would have been no need to repeat the dietary interviews to determine the groups' dietary pattern under ordinary conditions.

However, individual data for the two years showed considerable variation. This may be

due to various factors: First, the interview method is far from infallible; in fact, it can be grossly inaccurate. It does, however, seem to place groups in several broad classifications. The mean daily caloric intake of a sedentary group of university faculty members was estimated by us to be 2,460 calories, using the same tool.¹¹ This intake is approximately 900 to 1,000 calories less than the caloric intake estimated for these active factory workers. Second, the natural variation in adult eating patterns from one period to another may be quite large. Change in occupation or activity may account for some differences. In addition, even though the quality of the diet may not change, the quantity people eat may vary. The dietary interview may pick up these changes and reflect current eating practices and not long range eating patterns.

It is extremely difficult to determine a person's dietary pattern; the only accurate method is actual food analysis. The next most reliable method is to weigh all food consumed. These are obviously not practical measures for epidemiologic studies. Although the dietary interview has shortcomings, it was the most practical method for this study.

SUMMARY

A repeat study, after a two-year interval, was carried out on 147 Italian-American factory workers.

For the group there were no significant changes in serum cholesterol levels or relative weight although some persons showed considerable change.

The mean serum cholesterol level of smokers of one or more packages of cigarettes a day was significantly higher and their relative weight was significantly lower than that of nonsmokers.

The repeat diet histories showed no significant mean differences in calories or grams of fat and protein for the group, but individual variations were found.

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