A CRITIQUE OF THE EVIDENCE RELATING DIET AND CORONARY HEART DISEASE

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It may be useful for me to review the problem of coronary heart disease (CHD) from the special viewpoint of a nutritionist. While this view may have some prejudice it seems relevant because of the frequent association of diet with CHD and the widespread lay interest in the problem.

Coronary heart disease may seem to have risen like an epidemic among us. It is a complicated task to determine whether this rise to prominence is real or only made apparent by changing techniques. It would be an interesting task for someone to relate the time course of the prevalence of CHD to the marketing of electrocardiographs. To my knowledge this has not been done. One might have expected a rise of CHD when the ECG became available for diagnosis. Dr. Lew of the Metropolitan Life Insurance Company has shown a remarkable explanation for the distribution by states of coronary heart disease in the United States (1)(2), (Fig. I and II). It must be clear that we see what we look for.

A more subtle influence is that of "competing causes" (3). Even when age specific rates are considered we may be baffled in understanding the entire effect of the removal of diseases which typically kill at an earlier age than does coronary heart disease.

The errors of reporting cause of death are well known (4). It is less than even money that an autopsy will confirm the clinical impression and only a small proportion of all deaths are followed by necropsy. Since reporting causes of death, like ladies hats, tends to change with fashion it is easily possible for the mortality rates to be strongly influenced by the current fashion and this is conveniently done since the selection of the first cause in the presence of multiple causes of death will determine the final tabulations.

Finally we must concede that it is possible that an apparent rise of prevalence of coronary heart disease is real and that this is a reflection

of the introduction of a new and potent causal factor that we must identify and adjust in order to control CHD.

The interest of nutritionists in this problem like their interest in most diseases stems from the ancient judgement that a man may be sick because of "something he et". This explanation has proved so attractive that we have a second epidemic, a scourge of nutritionists. These newcomers, coupled with the food industries, have made food and feeding a highly complicated and even dangerous business.

The essential series of hypotheses upon which most research is presently based may be shown as follows:

Diet [1] Hypercholesteremia [2] Atherosclerosis [3] Clinical Events

The evidence to support the first relationship is at best indecisive. The question was brought to prominence by A. Keys (5) who based this contention on a curious selection of food-mortality data of the World Health Organization (Fig. III). Aside from the fact that the hypothesis is based on tenuous population data that might as easily be explained in other ways (6) it has proven impossible to show in retrospective studies that persons with CHD eat differently than those without (Fig. IV).

The dietary behavior of 983 persons in the Framingham Study has been measured by Georgiana Pearson in the past four years (7)(8)(9). The reproducibility of the method whether by one person (Fig. V) or by a second observer (Fig. VI) is good. We are confident that these people were well classified but we can find no relationship between either cholesterol level (Table 1) or experience with CHD and the way these people eat. Morris, Marr and Heady (10) have found no diet-cholesterol disease relationship in their population of bank clerks (11). Their method of measuring diet does not reproduce quite as well as ours. (Table 2).

The entire problem is complicated by the prevailing imprecision of the measurement of cholesterol. Consider, for example, the data of Rivin (12) (Table 3) who compares hospital and commercial laboratories. We have compared several methods applied in a research setting (13) (Table 4). If one adds to this technical variation the considerable biological variation of serum cholesterol with time (14) it is clear that the

central element of the hypothesis may be so badly estimated that this disqualifies our most convenient index (Table 5).

We are at least as bad off in measuring atherosclerosis, the anatomical lesion we believe to be the basis for the clinical disorders. We cannot visualize these lesions in life and even after death to do more than make qualitative descriptions is difficult. You can appreciate that an element of probability determines whether the plaque is critically placed in the cardiovascular system.

The clinical manifestations of CHD are varied (Table 6). A disturbing number, disturbing at least for the biometrician, are completely occult events called "silent coronaries" because they do not cause important clinical signs. The cerebral events, strokes, are even more obscure because we have less precise ways to determine and localize these, having no equivalent for the ECG.

There are several prospective dietary studies under way which propose to change the experience with CHD by altering the diet. The dietary regimens of some of these are summarized in Table 7. The most ambitious of these called the National Diet Heart Disease Study is directed by Dr. Irvine Page and sponsored by the National Heart Institute (15). It is now in the feasibility phase, that is, the determination of whether families can be recruited, supplied with suitable food and kept under surveillance while consuming the diet for the measurement of cholesteremia and the evaluation of cardiovascular disease status. If proven feasible, this experiment will be extended to larger numbers in order to answer the critical question--will dietary changes modify the course of CHD?

The smaller trials of diet, for example, that of Dayton at Los Angeles (16) and Rinzler with the Anti-Coronary Club (17) in New York have usually obtained about a 15% reduction of serum cholesterol in the best circumstances, that is, when the starting level is high. However, many subjects who do follow the diet do not respond and some who respond initially drift back up with time. We must conclude that dietary treatment, if effective, is a relatively impotent agent. We must conclude also that diet has been overemphasized as a cause of CHD and that dietary modifications are proving relatively ineffectual control measures.

Table 1

DIETARY INTAKES - AMERICANS 1957-58

FRAMINGHAM HEART STUDY

ARRANGED BY SERUM CHOLESTEROL LEVEL

Men	N	Calories	Fat g.	Protein g.	Chol. mg.
High Cholesterol	17	3127	149	113	703
Low Cholesterol	39	3487	163	126	721
Random Sample	133	3333	157	122	735

Table 2

COMPARISON OF REPEATABILITY FOR 2 METHODS OF MEASURING DIET

Nutrient	Heady - Bank Clerks 1 week's weighed intake	Framingham research diet history
	r - consecutive weeks	r - 2 year interval
Calories	0.80	0.92
Protein (gm)	0.67	0.72
COH (gm)	0.84	0.90
Fat (gm)	0.79	0.88

Table 3

Cholesterol Measurement

Rivin, et al., J. A. M. A., 166:2108, 1959

Values in Mgm%

Serum	Author	V. A.	Univ.	Commercial 1.	Commercial 2.	Commercial 3.
A	529	479	480	598	513	411
	487	418	541	500	451	318
B	260	240	255	291	273	183
	273	233	296	263	272	191
C	218	213	275	312	255	180
	249	220	288	252	246	172
Method	K-S	K-S	B1	B1	PSG	Sheftel

Table 4

Evaluation of Methods for Serum Cholesterol

		Methods							
		Abell		FeSac		Pearson		Sackett	
Level (mgm%)	N	$\bar{X}$	T. E.	$\bar{X}$	T. E.	$\bar{X}$	T. E.	$\bar{X}$	T. E.
<210	15	188	6.4	180	5.6	179	7.7	237	3.2
211-274	15	232	4.1	228	5.7	225	8.8	288	3.2
275-499	14	368	5.2	384	7.6	340	15.1	452	12.9
>499	15	672	7.7	667	10.4	643	26.9	837	14.2
all levels	59	365	6.0	365	7.6	347	17.1	454	14.2

Table 5

Serum Cholesterol Variation

68 men - measured twice weekly - 10 weeks

S_T = total variation S_E = laboratory variation S_B = biological variable

where $NS_B^2 = NS_T^2 - 1/2\ NS_E^2$

$\overline{X}S_T = 20$

$\overline{X}S_E = 7$

$\overline{X}S_B = 13$

Then: For 95% assurance of effect 2 x 20 = 40 mgm % minimum change.

Table 6

THE MANIFESTATIONS OF CORONARY HEART DISEASE

Of 100 Men with "Events"

30 drop dead

20 are "silent"

10 die a little later

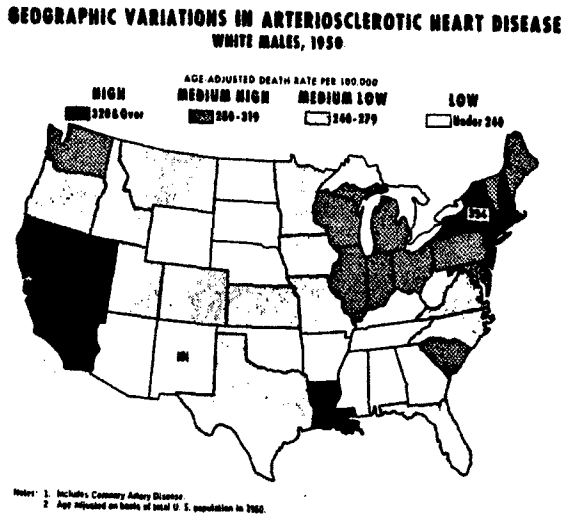
40 recover

Table 7

DIETARY REGIMENS -- OBSERVED AND FAT RESTRICTED

	Framingham (Men)	Page	Rinzler	Dayton	American Heart
Calories	3075	2000	2400	2430	2800
Protein (gm)	112	70	140	94	85
Fat (gm)	154	90	81	106	75
% Cal.	45	41	32	40	36
Cholesterol (mgm)	705	<200	200	380	200
PUS/S	0.3	1.5	1.0	1.7	1.1

Figure I



Data of Enterline and Stewart, Reference 1.

Figure II

CORRELATION BETWEEN MORTALITY FROM ARTERIOSCLEROTIC HEART DISEASE AND INTERNISTS PER 100,000 WHITE PERSONS

United States 1950

Region	Age-adjusted Death Rate per 100,000	Number of Internists** per 100,000
Middle Atlantic	273	12.6
New England	250	10.5
Pacific Coast	233	9.7
East North Central	214	7.3
South Atlantic*	193	7.6
West North Central	183	6.7
Mountain	179	6.5
West South Central	176	5.8
East South Central	160	4.5

* Excludes District of Columbia
** Includes cardiologists

Includes Coronary Heart Disease. Death rates age adjusted on basis of total U.S. population in 1950.

This material was published by E. A. Lew - Reference 2.

Figure III

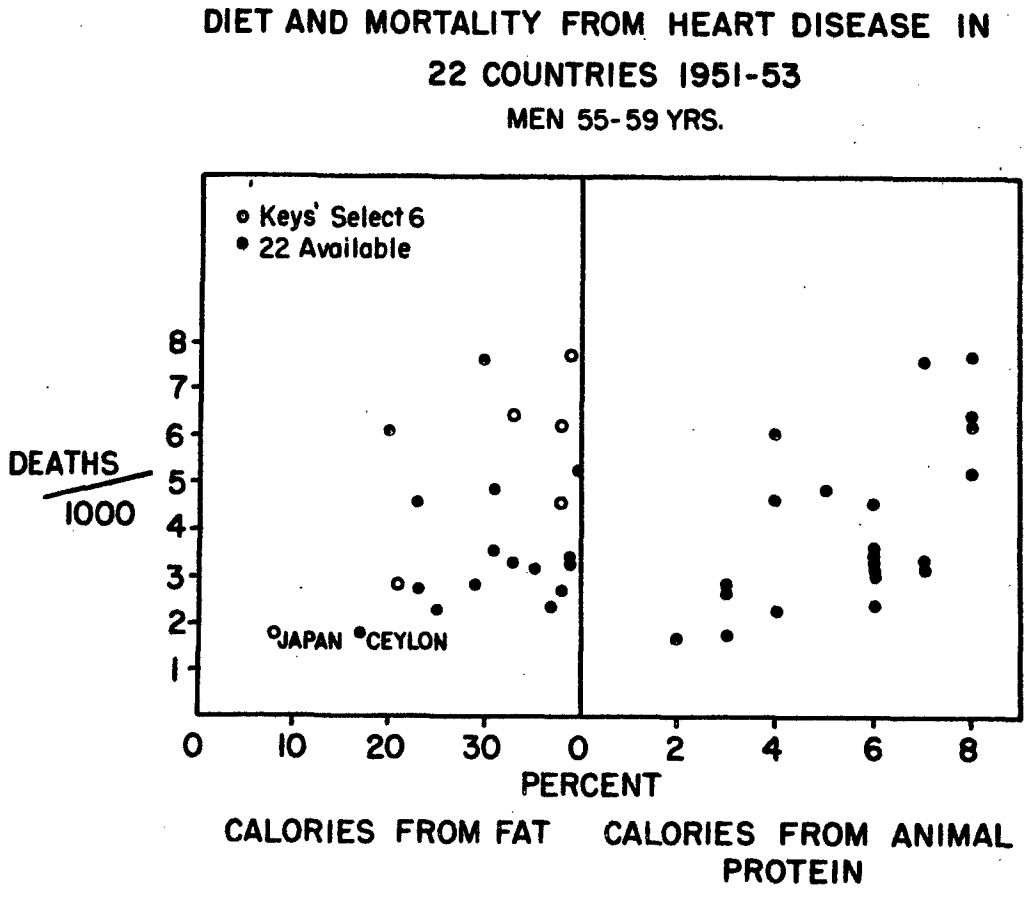

DIET AND MORTALITY FROM HEART DISEASE IN
22 COUNTRIES 1951-53
MEN 55-59 YRS.
o Keys' Select 6
• 22 Available
DEATHS / 1000
8
7
6
5
4
3
2
1
°JAPAN •CEYLON
0
10
20
30
0
2
4
6
8
PERCENT
CALORIES FROM FAT
CALORIES FROM ANIMAL PROTEIN

Figure IV

OBSERVATION OF DIET PATTERN AND EXPERIENCE WITH CORONARY HEART DISEASE

Observer		Association Observed
Wilkinson	Michigan	no
Rosenman	California	no
Zukel	North Dakota	no
Mann	Massachusetts	no
Morris	London	no
Keys	Minnesota	?

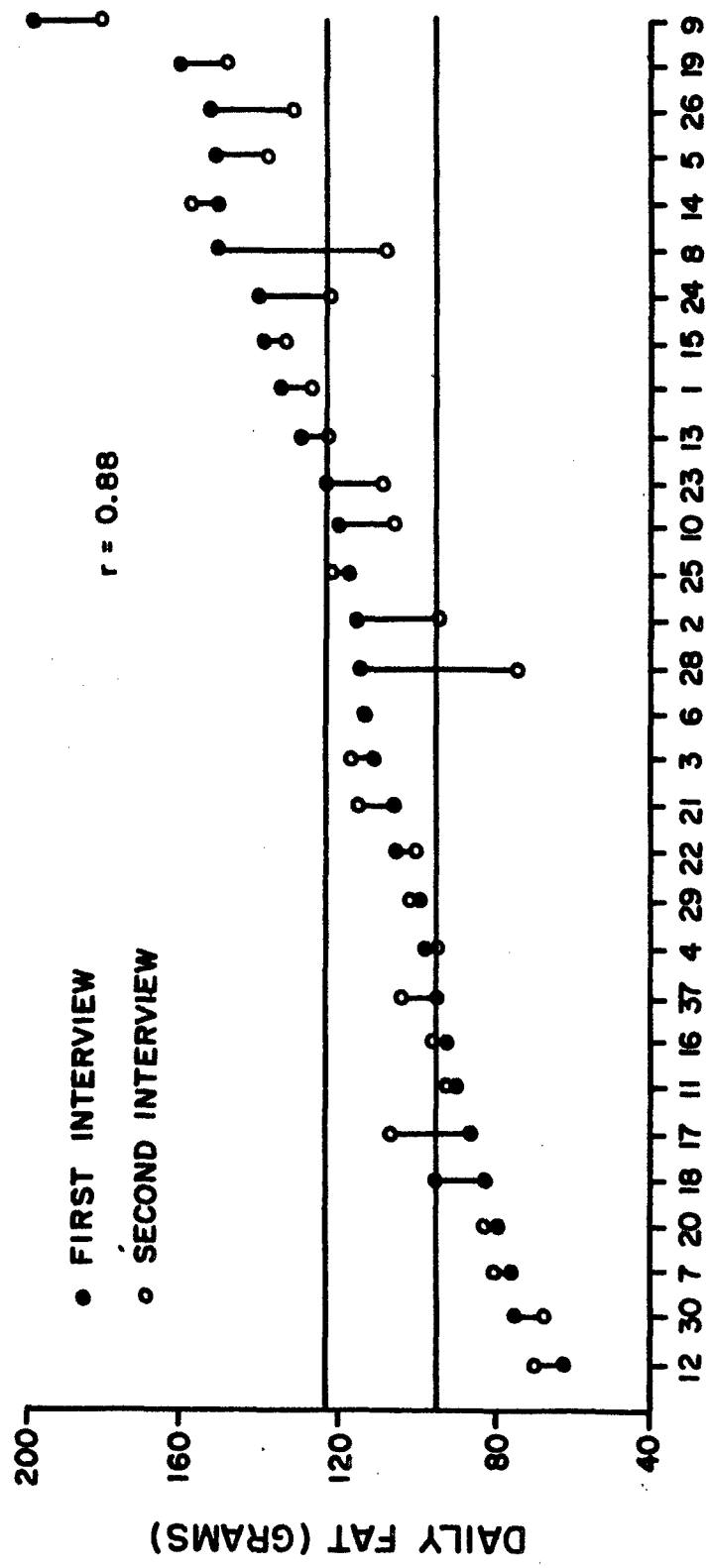
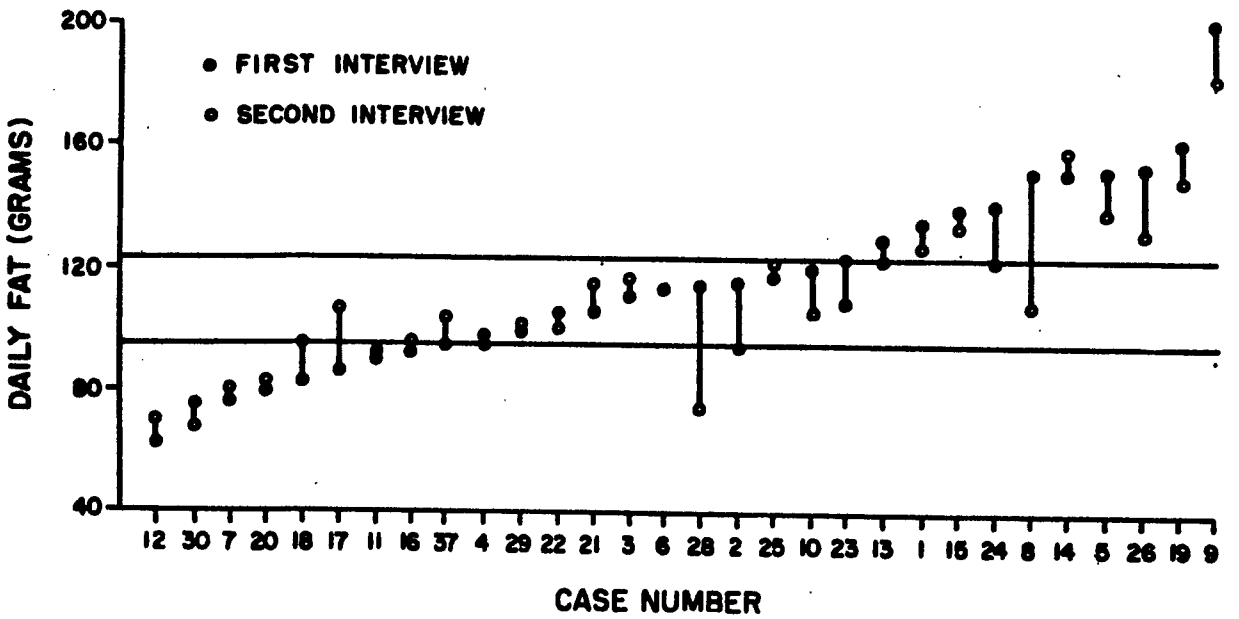

1 INTERVIEWER - 2 YEAR INTERVAL
r = 0.88
● FIRST INTERVIEW
o SECOND INTERVIEW
DAILY FAT (GRAMS)
200
160
120
80
40
CASE NUMBER
12 30 7 20 18 17 11 16 37 4 29 22 21 3 6 28 2 25 10 23 13 1 15 24 8 14 5 26 19 9

Figure V

Figure VI


200
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DAILY FAT (GRAMS)
FIRST INTERVIEW
SECOND INTERVIEW
12 30 7 20 18 17 11 16 37 4 29 22 21 3 6 28 2 25 10 23 13 1 15 24 8 14 5 26 19 9
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