Coronary Heart Disease in the Western Collaborative Group Study

Final Follow-up Experience of 8½ Years

Ray H. Rosenman, MD; Richard J. Brand, PhD; C. David Jenkins, PhD; Meyer Friedman, MD; Reuben Straus, MD; Moses Wurm, MD

• **Clinical coronary heart disease (CHD) occurred in 257 subjects during eight to nine years of follow-up (average, 8½ years) in a prospective study of 39- to 59-year-old employed men. Incidence of CHD was significantly associated with parental CHD history, reported diabetes, schooling, smoking habits, overt behavior pattern, blood pressure, and serum levels of cholesterol, triglyceride, and β-lipoproteins. The type A behavior pattern was strongly related to the CHD incidence, and this association could not be explained by association of behavior pattern with any single predictive risk factor or with any combination of them.**

(*JAMA* 233:872-877, 1975)

OUR EARLIER studies indicated a significant association between the type A behavior pattern and both the prevalence[1-3] and incidence[4] of clinical coronary heart disease (CHD). Pattern A is characterized by enhanced aggressiveness, ambitiousness, competitive drive, and chronic sense of time urgency.[1,2] The converse, more relaxed, type B subject exhibited substantially lower CHD incidence[4] and less basic atherosclerosis.[5] The association of various facets of pattern A with increased levels of CHD risk factors and higher CHD prevalence has been confirmed by other investigators.[6-10]

Keys[11] recently observed that the classical risk factors account for only about half of the CHD incidence in middle-aged American men and that other variables contribute significantly to the incidence. The present findings indicate that the behavior pattern is one such important factor.

From the Harold Brunn Institute, Mount Zion Hospital and Medical Center, San Francisco (Drs. Rosenman and Friedman), the School of Public Health, University of California, Berkeley (Dr. Brand), the Department of Behavioral Epidemiology, Boston School of Medicine, Boston (Dr. Jenkins), the Research Laboratories, St. Joseph Hospital, Burbank, Calif (Drs. Straus and Wurm). Dr. Straus is now with the Department of Pathology, Providence Hospital, Portland, Ore.

Reprint requests to Harold Brunn Institute, Mount Zion Hospital and Medical Center, PO Box 7921, San Francisco, CA 94120 (Dr. Rosenman).

METHODS AND MATERIALS

The Western Collaborative Group Study (WCGS)[3] was initiated in 1960-1961 as a prospective epidemiological investigation of CHD incidence in 3,524 men, aged 39 to 59 years at intake, and employed in ten California companies. The methodology has been described in previous reports.[3,4] Comprehensive data were obtained at intake and annually until the study was terminated, providing eight to nine years of follow-up, at which time a sufficient incidence of CHD had occurred as to make it unlikely that further follow-up would provide additional significant information. The intake studies were accomplished over an 18-month period from June 1960 to December 1961. Annual resurveys were done during the calendar 12-month period, ending in December 1969, during which time the subjects were studied in order of intake, with minor exceptions. Excluded from longitudinal analyses were 78 men under or over specified intake ages, 141 subjects with CHD manifest at intake, 106 employees of one firm that excluded itself from follow-up, and 45 subjects who were lost to the study because of early relocation, non-CHD death, or self-exclusion prior to the first follow-up. This left 3,154 initially well subjects at risk for CHD. Manifest CHD occurred in 257 subjects during the follow-up period, and death occurred in 140 subjects: 31 of their initial CHD event, 19 of a recurring CHD event, and 90 of non-CHD causes, including seven subjects who had developed manifest CHD. The remaining subjects were considered to be non-CHD cases, including 2,391 subjects who were examined throughout the entire period of follow-up and 423 subjects who were variously lost to follow-up. The death rate per 1,000 person-years was 2.10 from CHD events and 3.78 from non-CHD causes.

The behavior pattern was classified at intake from the tape-recorded, structured interview developed for this purpose[3] and administered by trained interviewers. The final rating was made after audition of the tape-recorded interview and without knowledge of other intake-history or measurement. This was done to avoid possible bias introduced by knowledge of subjects' other attributes. The 3,154 subjects at risk included 1,589 assessed as exhibiting type A behavior patterns and 1,565 assessed as exhibiting type B behavior patterns. Death from CHD events occurred in 34 type A and 16 type B subjects and from non-CHD causes in 51 type A and 39 type B subjects, including five type A and two type B subjects with manifest CHD. The death rate per

Table 1.—Prospective History

	Intake Age 39-49 yr				Intake Age 50-59 yr			
	Total Subjects	Subjects With CHD*	CHD Rate†	Significance‡ (P)	Total Subjects	Subjects With CHD	CHD Rate†	Significance‡ (P)
No of Subjects	2,249	145	7.6		905	112	14.6	
Schooling								
High school or less	961	77	9.4	.05	463	66	16.8	.01
Some college	300	17	6.7		131	22	19.8	
College graduate	987	50	6.0		311	24	9.1	
Annual income								
<$10,000	1,023	65	7.5	NS	368	41	13.1	NS
$10,000-$14,999	904	59	7.7		307	47	18.0	
≥$15,000	320	21	7.7		228	24	12.4	
Medical history								
Parental CHD	411	38	10.9	.025	167	27	19.0	NS
No parental CHD	1,838	107	6.9		738	85	13.6	
Diabetes history	74	9	14.3	.05	56	11	23.1	NS
No diabetes history	2,175	136	7.4		849	101	14.0	
Physical activity at work								
Sedentary and light	2,048	133	7.6	NS	800	96	14.1	NS
Moderate and heavy	200	12	7.1		103	15	17.1	
Exercise habits								
None or occasional	1,689	118	8.2	NS	649	90	16.3	.05
Regular	560	27	5.7		256	22	10.1	
Smoking habits								
Never smoked	536	19	4.2	.001	179	15	9.9	NS
Pipe or cigar only	407	17	4.9		159	19	14.1	
Former cigarette	239	16	7.9		132	12	10.7	
Current cigarette	1,067	93	10.3		435	66	17.9	
Current cigarette smoking								
None	1,182	52	5.2	.03	470	46	11.5	.02
Yes	1,067	93	10.3		435	66	17.9	
1-15/day	214	11	6.0	.001	108	9	9.8	.01
16-25/day	433	36	9.8		164	26	18.7	
26+/day	420	46	12.9		163	31	22.4	
Systolic blood pressure, mm Hg								
<120	592	21	4.2	.001	175	11	7.4	.001
120-159	1,597	112	8.3		664	85	15.1	
≥160	60	12	23.5		66	16	28.5	
Diastolic blood pressure, mm Hg								
<95	2,070	126	7.2	.05	792	89	13.2	.01
≥95	179	19	12.5		113	23	23.9	
Serum total cholesterol, mg/100 ml								
<220	1,093	35	3.8	.001	359	26	8.5	.001
220-259	728	52	8.4		321	46	16.9	
≥260	421	58	16.2		220	40	21.4	
Fasting serum triglycerides, mg/100 ml								
<100	600	19	3.7	.001	250	21	9.9	.05
100-176	1,038	70	7.9		408	48	13.8	
≥177	496	50	11.9		212	35	19.4	
Serum β-/α-lipoprotein ratio								
<2.01	1,291	59	5.4	.001	487	45	10.9	.01
2.01-2.35	278	22	9.3		99	16	19.0	
≥2.36	674	64	11.2		313	50	18.8	
Behavior pattern								
Type A	1,067	95	10.5	.001	522	83	18.7	.001
Type B	1,182	50	5.0		383	29	8.9	

*Coronary heart disease. †Average annual rate/1,000 subjects at risk. ‡Analyzed by χ^2 test. NS indicates not significant at $P<.05$.

1,000 person-years was 2.92 for type A and 1.32 for type B subjects for CHD causes, and 4.38 for type A and 3.21 for type B subjects for non-CHD causes. The 2,391 subjects without manifest CHD included 1,129 type A and 1,262 type B subjects. The 506 men who were lost on or before final follow-up are also considered to be non-CHD cases and include 282 type A and 224 type B subjects. The total number of person-years of follow-up was 11,642 for type A and 12,148 for type B subjects. Thus, there was a slightly greater loss to follow-up of type A than of type B men, proportionately speaking. The excess of type A men in the CHD-incidence group, accordingly, is not a function of a greater loss of type B subjects from the initial populations at risk. Association between behavior pattern and CHD is slightly underestimated by using CHD rates based on number at risk at intake rather than on person-years of exposure to risk. Nevertheless, in what follows, rates based on number at risk at intake are required by the multivariate adjustment method to be described here

Table 2.—Mean Values

	Intake Age 39-49 yr			Intake Age 50-59 yr		
	Total Subjects	Subjects With CHD*	Significance† (P)	Total Subjects	Subjects With CHD	Significance† (P)
No. of Subjects	2,249	145	...	905	112	...
Age, yr:						
All subjects	43.3±3.1‡	44.3±3.5	.01	53.6±2.7	54.0±2.8	.05
Type A subjects	43.4±3.1	44.4±3.5	NS	53.7±2.7	54.0±2.8	NS
Type B subjects	43.3±3.1	43.9±3.4	NS	53.5±2.7	53.8±3.0	NS
No. cigarettes/day (current smokers)	24.5±11.3	27.5±10.8	.03	24.0±11.9	26.2±11.0	.02
Height, cm	178±6	178±6	NS	176±6	176±6	NS
Weight, kg	77.2±9.6	79.3±9.9	.01	76.5±9.4	78.7±9.6	.01
Weight gain, kg§	5.7±6.9	6.1±7.2	NS	6.7±8.3	6.7±8.6	NS
Blood pressure, mm/Hg						
Systolic	127.4±14.2	132.9±15.5	.01	131.8±16.7	138.6±19.2	.01
Diastolic	81.4±9.6	83.8±9.9	.01	83.7±9.9	87.3±10.5	.01
Serum lipids						
Cholesterol, mg/100 ml	224.2±43.8	253.1±56.0	.01	231.9±41.9	246.1±39.0	.01
Triglycerides, mg/100 ml	146.2±84.0	166.9±77.0	.01	150.3±103.4	164.8±95.6	.01
β-/α-lipoprotein ratio	1.99±1.05	2.44±1.33	.01	2.08±1.10	2.34±1.00	.01

*Coronary heart disease.
†Analyzed by Student t-test. NS indicates not significant at $P<.05$.
‡Mean value ± standard deviation.
§Mean weight gain from age 25 yr to intake.

that plays a major role in data analysis.

All electrocardiograms were screened by a cardiologist while those considered definitely or probably indicative of myocardial infarction were referred to an independent medical referee who was solely responsible for all diagnosis of manifest CHD, and this selection was made in the absence of any knowledge of the variables under investigation.[9]

The category termed "symptomatic myocardial infarction (MI)" includes 135 subjects, of whom 31 died in association with their initial CHD event. The diagnosis of acute MI in 104 surviving subjects was based on the occurrence of a symptomatic CHD event accompanied by definitive electrocardiographic and serum enzyme changes. Postmortem examination was performed on 24 of the 31 deceased subjects and demonstrated the presence of acute coronary thrombosis or acute MI in 23 instances and of severe, diffuse, coronary atherosclerosis in one subject, who was found dead in bed. No other anatomic or toxicological findings were noted to controvert inclusion of this subject as a case of sudden CHD death. The diagnosis of acute MI was confirmed by antemortem hospital findings in four of the seven deceased subjects who were not autopsied. Three other deceased subjects who were not autopsied were included because of sudden death. One subject died suddenly while driving his car, and the other two subjects died suddenly. None of the three had any other acute or chronic illness that might controvert including them as cases of sudden CHD death.

The category termed "unrecognized MI" is herein used to designate 71 subjects whose interval ECG during annual resurvey was adjudged by the independent electrocardiographer and medical referee to show definite evidence of the occurrence of MI that, however, was either "silent" or clinically unrecognized. The category of "angina pectoris (without MI)" was devised for 51 subjects by the medical referee, on the basis of the development of classical Heberden disease, and excluded subjects whose symptoms were atypical or doubtful.

The analyses are based on intake data, except for fasting serum triglyceride levels, which were determined at the first annual resurvey examination. Among the 578 subjects with a history of parental CHD, 481 (83.2%) reported this at intake and the remaining 97 (16.8%) reported this during the first five years of follow-up. The statistical significance of categorical data was analyzed by the χ^2 test, and of continuous variables by Student t-test. For behavior pattern, a multivariate adjustment using the Mantel-Haenszel χ^2 method of analysis was utilized.[12] The association between behavior pattern and CHD incidence was adjusted one at a time and then in combination with other risk factors that were associated with the behavior pattern.

RESULTS

Single Predictive Factors and CHD Incidence

There were 3,154 intake subjects at risk for initial occurrence of CHD, 2,249 of whom were aged 39 to 49 years, and 905 aged 50 to 59 years. Clinical CHD was observed in 257 subjects during the mean 8½ years of follow-up, an average annual incidence of 9.6/1,000 subjects at risk. (Relevant intake findings in the 257 CHD subjects are compared with those of all subjects in Tables 1 and 2.) Descriptive results, in the form of CHD rates and means, are provided for assessing the magnitude of association between each risk factor and CHD to indicate clinical significance of findings. Measures of statistical

Table 3.—CHD* by Type of Manifestation and Behavior Pattern

	Intake Age 39-49 yr				Intake Age 50-59 yr				Intake All Ages			
	All Subjects	Type A	Type B	Significance‡	All Subjects	Type A	Type B	Significance‡	All Subjects	Type A	Type B	Significance‡
No. subjects at risk	2,249	1,067	1,182	...	905	522	383	...	3,154	1,589	1,565	...
Subjects with CHD												
No.	145	95	50		112	83	29		257	178	79	
Incidence†	7.6	10.5	5.0	.001	14.5	18.7	8.9	.001	9.6	13.2	5.9	.001
Subjects with myocardial infarction												
No.	120	79	41		86	62	24		206	141	65	
Incidence†	6.3	8.7	4.1	.001	11.1	14.0	7.3	.01	7.7	10.4	4.9	.001
Symptomatic												
No.	79	52	27		56	41	15		135	93	42	
Incidence†	4.1	5.7	2.7	.005	7.2	9.2	4.5	.025	5.0	6.9	3.2	.001
Unrecognized												
No.	41	27	14		3.0	21	9		71	48	28	
Incidence†	2.1	3.0	1.4	.05	3.9	4.7	2.7	NS	2.6	3.6	1.7	.01
Subjects with angina pectoris												
No.	25	16	9		26	21	5		51	37	14	
Incidence†	1.3	1.8	0.9	NS	3.4	4.7	1.5	.05	1.9	2.7	1.1	.005

*Coronary heart disease.
†Average annual rate per 1,000 subjects at risk.
‡Probabilities are based on χ^2 test of significance. NS indicates not significant at $P<.05$.

significance are provided to show the extent to which chance can be eliminated as an explanation of observed associations.

The educational level was inversely related to CHD incidence in both age groups, although annual income was not related to CHD rates. Subjects with a history of parental CHD and those with reported diabetes each exhibited higher CHD incidence of about the same proportion in both age groups, but statistical significance was not reached in the older group because of the smaller number of subjects. This exemplifies the difficulty in interpreting the possible difference between clinical and statistical significance. For example, the rate of CHD in older subjects with parental history of CHD was 5.4% higher than in those without such history, while the corresponding increment in the younger group was only 4.0% (Table 1). Nevertheless, because of the respective differences in the numbers of subjects involved, the observed findings reached statistical significance only in the younger group. However, the magnitude of the observed differences suggests clinical significance in both age groups.

Reported occupational-physical activity was not associated with differences in CHD rates. However, men reporting regular exercise habits (daily, purposeful calisthenics, walking, or hobby exercise) had lower CHD rates than those reporting only occasional avocational exercise, and differences were significant in the older group. Smoking habits were related to CHD incidence in both decades—with higher rates for current cigarette smokers—and rates of CHD were significantly related to reported daily amount smoked at intake.

There was no significant difference in the average weight gain between age 25 years and intake for subjects with or without CHD. However, subjects suffering CHD exhibited higher mean weights at intake. Average systolic and diastolic blood pressures, and serum levels of cholesterol and triglycerides, and β-/α-lipoprotein ratios were significantly higher in subjects of both age groups who later had CHD, compared to the non-CHD population, and the CHD rate was proportional to the degree of measured level of each factor. Significantly higher rates of CHD were observed in subjects of both age groups classified at intake as type A compared to those with the type B behavior pattern.

Different Initial Manifestations of CHD and Predictive Factors

Among the 257 subjects suffering clinical CHD during follow-up, the initial manifestation in 135 men was symptomatic myocardial infarction (including 19 subjects who died of sudden CHD death, as adjudged by history and postmortem findings), "silent" and clinically unrecognized myocardial infarction in 71, and classical angina pectoris without infarction in 51.

The incidence of symptomatic CHD events in the total population, including fatal and nonfatal infarction and sudden CHD death, as found at earlier follow-up[4] was significantly associated with parental history of CHD, cigarette smoking and the number smoked per day, the type A behavior pattern, both systolic and diastolic blood pressure, serum levels of cholesterol and triglycerides, and the β-/α-lipoprotein ratio. The incidence of "silent" and clinically unrecognized myocardial infarction and of angina pectoris was also associated with each of these factors in a similar direction, but the differences did not reach statistical significance in every instance. Thus, the incidence of unrecognized infarction was significantly associated (probability [P] $<.05$) with cigarette smoking and the number smoked daily, with systolic blood pressure, and with behavior pattern type A. The incidence of angina pectoris was significantly associated with parental history of CHD, reported diabetes, systolic and diastolic blood pressure, serum cholesterol level, and behavior pattern type A.

Table 4.—Prospective History and Findings by Behavior Pattern

	Age 39-49 yr						Age 50-59 yr					
	Subjects at Risk		Subjects With CHD*		Rate of CHD†		Subjects at Risk		Subjects With CHD		Rate of CHD†	
	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B	Type A	Type B
No. of subjects	1,067	1,182	95	50	10.5	5.0	522	383	83	29	18.7	8.9
Parental history of CHD												
Yes	214	197	23	15	12.6	9.0	103	64	20	7	22.8	12.9
No	853	985	72	35	9.9	4.2	419	319	63	22	17.7	8.1
Smoking habits												
Never smoked	221	315	11	8	5.9	3.0	90	89	10	5	13.1	6.6
Pipe or cigar	191	216	11	6	6.8	3.3	81	78	17	2	24.7	3.0
Former cigarette	110	129	11	5	11.8	4.6	91	41	10	2	12.9	5.7
Current cigarette	545	522	62	31	13.4	7.0	260	175	46	20	20.8	13.4
Current cigarette usage												
None	522	660	33	19	7.4	3.4	262	208	37	9	16.6	5.1
1-15 day	95	119	3	8	3.7	7.9	65	43	8	1	14.5	2.7
≥16/day	450	403	59	23	15.4	11.4	195	132	38	19	22.9	16.9
Systolic blood pressure, mm Hg												
<120	264	328	17	4	7.6	1.4	95	80	7	4	8.7	5.9
120-159	771	826	69	43	10.5	6.1	381	283	64	21	19.8	8.7
≥160	32	28	9	3	33.1	12.6	46	20	12	4	30.7	23.5
Diastolic blood pressure, mm Hg												
<95	970	1,100	81	45	9.8	4.8	448	344	64	25	16.8	8.5
≥95	97	82	14	5	17.0	7.2	74	39	19	4	30.2	12.1
Serum cholesterol, mg/100 ml												
<220	486	607	24	11	5.8	2.1	211	148	20	6	11.2	4.8
220-259	352	376	32	20	10.7	6.3	179	142	36	10	23.7	8.3
≥260	226	195	39	19	20.3	11.5	130	90	27	13	24.4	17.0
Fasting serum triglycerides, mg/100 ml												
<100	252	348	12	7	5.6	2.4	151	99	16	5	12.5	5.9
100-176	500	538	48	22	11.3	4.8	238	170	37	11	18.3	7.6
≥177	247	249	30	20	14.3	9.6	114	98	26	9	26.8	10.8
Serum β-/α-lipoprotein ratio												
<2.36	733	836	57	24	9.1	3.4	323	263	43	18	15.7	8.1
≥2.36	331	343	38	26	13.5	8.9	196	117	39	11	23.4	11.1

*Coronary heart disease.

†Average annual rate/1,000 subjects at risk. Difference of rates between type A and type B subjects are tested for significance by Mantel-Haenszel χ^2, with adjustment for factors indicated. For each factor the adjusted association between behavior pattern and CHD incidence is significant at $P<.001$.

Postmortem findings in most of the subjects who died of initial or recurring CHD events, as well as of all causes, have been carefully collected. The relationship of the prospectively studied variables to the degree of coronary atherosclerosis and to the mechanism of CHD death will be separately reported, since the findings are too extensive for inclusion in the present discussion. Data regarding fatal cases, accordingly, are not reported herein.

CHD Incidence and Behavior Pattern

Table 3 shows CHD incidence in the two age groups by type of initial manifestation in subjects with type A and type B behavior. In the younger group, type A behavior was significantly associated with incidence of both symptomatic and unrecognized infarction. The twofold higher incidence of angina pectoris in type A compared to type B subjects was not statistically significant because of the relatively small number of subjects in this category. In the older group, type A subjects had significantly more symptomatic infarction and angina pectoris. The observed relationship of the behavior pattern to the incidence of unrecognized infarction in the two age groups emphasizes again the difference between clinical and statistical significance. Thus, a 2% difference in the incidence of unrecognized infarction between type A and type B subjects in the older group did not reach statistical significance, while a 1.6% difference in the younger group was statistically significant (Table 3). The magnitude of the observed differences suggests that they are both clinically important, even though the differences did not reach statistical significance in both age groups.

In view of the association of type A with other risk factors for CHD, it was important to reexamine the inci-

dence of CHD in type A and type B subjects stratified against all factors found to be significantly related to the CHD incidence.[4] The results of this survey are shown in Table 4. The higher CHD incidence in type A subjects prevailed when subjects were stratified by each of the predictive risk factors. The type A and type B subjects exhibited no significant differences of mean age, height, or weight. These results were corrected for each single risk factor in studying the association between the behavior pattern and the CHD incidence. No single risk factor had a substantial impact on the degree of association.

The possibility that the combination of effects of all risk factors may explain a substantial part of the behavior pattern-CHD association then was studied by the Mantel-Haenszel procedure[12] in each age group. This method of analysis, in addition to providing a test of statistical significance, gives a summary measure of association, which is computed in a way that is analogous to direct adjustment of rates. The resulting measure can be interpreted, in this case, as an approximate relative risk that gives the ratio of the CHD rate in type A subjects divided by the CHD rate in type B subjects.

In this analysis, the behavior pattern-CHD relationship was viewed when simultaneous adjustment was made for parental history of CHD, current cigarette usage, systolic and diastolic blood pressure, serum levels of cholesterol and triglyceride, and β-/α-lipoprotein ratios, all treated as categorical variables as indicated in Table 4. Simultaneous adjustment eliminates any apparent increase of CHD risk in type A subjects that stems from the tendency of these subjects to have a relatively higher occurrence of any of these other risk factors. In the younger age group, the approximate relative risk (odds ratio[13]), which assesses the association between behavior pattern and CHD incidence is 2.21 ($P < .0001$) before adjustment and 1.87 ($P < .003$) after adjustment for the other risk factors. In the older group, the ratio is 2.31 ($P < .0002$) before adjustment and 1.98 ($P < .019$) after adjustment. The results of these analyses thus indicated that the predictive relationship of the behavior pattern to the CHD incidence could not be "explained away" by other risk factors, a finding similar to that at the 4½-year follow-up in which the same issue was studied by means of both bivariate and multivariate analyses.[4]

COMMENT

Epidemiological studies have confirmed a relationship between the incidence of clinical CHD and prospective risk factors, including age, parental history of premature CHD, elevated systolic and diastolic blood pressures, cigarette smoking, and higher serum concentrations of cholesterol, triglycerides, and β-lipoproteins. These findings are again confirmed in the present 8½-year follow-up of a large population. However, the predictive relationship of any single risk factor with the incidence of CHD may be a reflection of its association with other risk factors. Accordingly, any attempts at causal interpretation of the data observed in these univariate analyses requires caution. It is beyond the scope of the present report to investigate the multivariate relationships of all of the risk factors studied herein, as was done for the behavior pattern. Although these factors are important in prediction of relative risk of CHD, even the combination of such risk factors cannot definitively predict CHD in prospective studies of middle-aged American men, indicating that other variables must play an important pathogenetic role in the CHD incidence.[11]

The present findings reaffirm earlier follow-up studies[4] and indicate that the overt behavior pattern is prominent among variables in the list of major risk factors. The results also confirm that this relationship is not the artifact of the association of the behavior pattern with other risk factors and suggest that the pathogenetic force of type A behavior on the CHD incidence is due primarily to factors other than the classical risk factors, perhaps operating through various neurohormonal pathways. However, it seems clear that behavior pattern A indicates a pathogenetic force operating in addition to, as well as in conjunction with, the classical risk factors.

The findings would appear to have important clinical implications for the primary prevention of CHD. Moreover, evaluating patients with CHD for presence of the coronary-prone behavior pattern may well improve the prognostic prediction of the course of the disease. It has not yet been shown whether altering facets of the behavior pattern in surviving type A CHD patients reduces their risk of reinfarction, but research along these lines is strongly indicated.

This study was supported by the National Heart and Lung Institute, research grant HL-03429.

Herman N. Uhley, MD, screened all the ECGs; Harold Rosenblum, MD, served as independent medical referee; and Robert I. Sholtz, MS, assisted in the analysis of the data.

References

1. Friedman M, Rosenman RH: Association of specific overt behavior pattern with blood and cardiovascular findings: Blood cholesterol level, blood clotting time, incidence of arcus senilis and clinical coronary artery disease. *JAMA* 169:1286-1296, 1959.

2. Rosenman RH, Friedman M: Association of specific behavior pattern in women with blood and cardiovascular findings. *Circulation* 24:1173-1184, 1961.

3. Rosenman RH, Friedman M, Straus R, et al: A predictive study of coronary heart disease: The Western Collaborative Group Study. *JAMA* 189:15-26, 1964.

4. Rosenman RH, Friedman M, Straus R, et al: Coronary heart disease in the western collaborative group study: A follow-up experience of 4½ years. *J Chronic Dis* 23:173-190, 1970.

5. Friedman M, Rosenman RH, Straus R, et al: The relationship of behavior pattern A to the state of the coronary vasculature: A study of 51 autopsy subjects. *Am J Med* 44:525-537, 1968.

6. Brozek J, Keys A, Blackburn H: Personality differences between potential coronary and non-coronary subjects. *Ann NY Acad Sci* 134:1057-1063, 1966.

7. Caffrey B: Behavior patterns and personality characteristics related to prevalence rates of coronary heart disease in American monks. *J Chronic Dis* 22:93-103, 1969.

8. Liljefors I, Rahe RH: An identical twin study of psychosocial factors in coronary heart disease in Sweden. *Psychosom Med* 32:523-542, 1970.

9. Jenkins CD: Psychologic and social precursors of coronary disease. *N Engl J Med* 284:244-255, 307-317, 1971.

10. Ganelina IE, Kraevskij JM: Premorbid personality traits in patients with cardiac ischemia. *Cardiologia* 2:40-45, 1971.

11. Keys A: The epidemiology of coronary heart disease. *CVD Epidemiology Newsletter*, 1972, pp 2-5.

12. Mantel N, Haenszel W: Statistical aspects of the analysis of data from retrospective studies of disease. *J Natl Cancer Inst* 22:719-748, 1959.

13. Fleiss JL: *Statistical Methods for Rates and Proportions*. New York, John Wiley & Sons, Inc, 1973, pp 43-46.