Occupation, Education, and Coronary Heart Disease

Risk is influenced more by education and background than by occupational experiences, in the Bell System.

Lawrence E. Hinkle, Jr., L. Holland Whitney
Edward W. Lehman, James Dunn, Bry Benjamin
Robert King, Arlene Plakun, Betty Flehinger

This article describes an effort to test the theory that coronary heart disease may be, in part, an outcome of the adult behavior of those who exhibit the disease, or of their reactions to their life situations. Some of those who have advanced this theory have attributed an enhanced risk of coronary heart disease to a behavior pattern innate to the person, or developed early in his life; others have considered it to be the result of his response to his occupation or to various life situations that he may encounter. In general, it has been reported that coronary heart disease occurs especially in people who work unremittingly and under pressure in order to accomplish tasks (*1–4*). Such people have been described as "striving people" who are "competitive" and "hard working." It has been reported that people having these characteristics can be found in large numbers in certain occupational groups (*1*, *5–7*), and that they can be identified by interviews (*8*, *9*) or psychological tests (*10–12*) as well as by evidence of their restlessness (*8*). People identified by such means have been reported to have a greater than expected morbidity from subsequent coronary heart disease (*13*). It has been suggested that such restless "mobilized" people are more susceptible to atherosclerosis because they have a relatively higher level of various lipid fractions in their blood (*6*). It has also been suggested that they are more susceptible to acute coronary occlusion at times of stress because they have an increased tendency to intravascular clotting at such times (*6*), and it has been implied that they may be more susceptible to acute arrhythmias or to ventricular fibrillation because of neurohormonal influences on the myocardium which are reflected by an increased excretion of catecholamines (*14*).

Dr. Hinkle is director of the Division of Human Ecology of the Departments of Medicine and Psychiatry, Cornell University Medical College, New York. Dr. Whitney is medical director of the American Telephone and Telegraph Company. The other authors are connected with the Division of Human Ecology, Cornell University Medical College.

Methods of the Study

These studies were designed to examine the behavior of men in a large American industry, their habits, their personality traits, some of their physiological characteristics, and the occurrence of coronary heart disease among them. The 270,000 men employed by the Bell System Operating Companies have been the population base for these investigations. They provide a rather large sample of American men, who are engaged in occupations like those of many men throughout the country, and are working within a social organization similar to a great many others in the United States (*15*). They are an unusually homogeneous population. The operating units of the Bell System are quite similar and closely interrelated. Wherever they may be located in the United States, all the men in these units are engaged in a relatively small number of highly specifiable and highly comparable occupations. Almost all of them are career employees who were hired in their early 20's, and all of them have been covered by comparable sickness benefit programs throughout their careers.

The men in the Bell System experience coronary heart disease at a rate comparable to that of other American men. They also experience many of those forms of social mobility which are believed to be characteristic of an industrial society, including the upward organizational mobility that is widely believed to be associated with the sustained purposeful effort that has been called "striving behavior." They fall into three major "mobility groups": (i) 183,000 men without college degrees who were hired as skilled workmen, and who have remained skilled workmen throughout their careers; (ii) 65,000 men without college degrees who were hired as skilled workmen but who have advanced to various levels of management; most of these men are foremen and supervisors, but some have attained the highest levels of management; (iii) 22,000 men with college degrees who were hired in their 20's with the expectation that they would become managers. These men have had the same managerial experience as the managers without college education (*16*), but a larger proportion of them have attained the higher levels of management (Table 1).

For many years morbidity and mortality data have been collected from this population and coded according to the International Classification of Diseases. In 1961 arrangements were made so that the clinical data on each new illness and each death reported under Rubric 420 were investigated and reviewed by a company physician according to a prearranged schedule, which provided an indication of the clinical, biochemical, electrocardiographic and pathological bases on which the diagnosis had been made. Company physicians were instructed in the use of this schedule, and beginning on 1 January 1962 these data were reported each quarter to investigators at the Cornell University Medical College, in New York. There each questionnaire was checked for completeness and accuracy, and incomplete reports were returned for further investigation. Direct contact between the investigators and company medical departments was maintained throughout the period of the survey. In New York, two physicians on the Cornell investigational staff, working independently, classified each episode according to the criteria of the AHA–USPHS Conference on the Epidemiology of Cardiovascular Disease Methodology (*17*). Concordance between the reviewers' classifications was

obtained in more than 90 percent of the episodes. Disagreements were resolved by independent review by a third reviewer.

Quality of the Medical Data

Three steps were taken to evaluate the accuracy and completeness of the data reported from this survey, as follows.

1) Throughout the period of the study all men in the Bell System were eligible to receive sickness benefits if they had any period of disability lasting 8 days or more, and death benefits if they died while on active duty. This made it possible to use the accounting records to check on the completeness of the medical reporting. A list of all deaths of both men and women for which death benefits were paid in the years 1962 to 1966 was obtained by the Cornell investigators. Whenever the accounting records showed evidence of a male death that might represent a coronary death for which no report of a medical investigation had been received, this was investigated by a direct contact with the company medical department, and the available clinical and diagnostic data were obtained. In this manner, medical reports of the type described above were obtained for 99.3 percent of all cases regarded as potential coronary deaths.

2) In order to check on the diagnostic classification of death data, copies of the original death certificates of 1391 of the 1418 deaths that occurred among men and women on active duty in the Bell System Operating Companies in 1964 were obtained by Cornell investigators. All of these were coded independently by a single trained registrar of the Bureau of Vital Statistics of the Health Department of the City of New York (Table 2). Assuming that the coding of the independent registrar was correct, and regarding "Rubric 420" cases not reported to Cornell as "false negatives," the Cornell classification of deaths as "definite" or "probable" coronary heart disease was found to have a specificity of 96.2 percent and a sensitivity of 89.8 percent. However, in some instances in which the classifications were different, the Cornell reviewers had received reports of clinical and laboratory data supplied by physicians and hospitals in addition to the death certificates, which made it likely that the Cornell classification was more accurate than the registrar's classification, which was based on the death certificate alone.

Table 1. Bell System men by level and education, 1963–1965 (annual average number of men in each category). NC, "no college"; C, "college."

Level	Function	Total	Education		Ratio NC : C
			"No college"	"College"	
5–7	Executives	1,477	325	1,152	1.0 : 3.5
4	General area managers	2,787	833	1,954	1.0 : 2.3
3	Local area managers	8,654	3,636	5,018	1.0 : 1.4
2	Supervisors	29,346	21,030	8,316	2.5 : 1
1	Foremen and other first-level managers	42,850	39,065	3,785	10.3 : 1
0	Skilled workmen and others not in management	184,641	183,395	1,246	147.2 : 1
	Totals	269,755	248,284	21,471	11.6 : 1

3) A less direct procedure had to be used to check on the accuracy of the diagnostic classification of morbidity data. Since the Benefit Accounting Departments of many Bell System companies do not prepare separate IBM cards for each episode of sickness-absence as they do for each death, individual absences could not be totally retrieved and investigated on a random basis. As an initial step the relative accuracy of diagnostic classifications of sickness-absences in two companies was evaluated in conjunction with other phases of these investigations in which men who had been identified by the company as being with or without coronary heart disease were independently examined at Cornell. This indicated that, with few exceptions, cases classified by the company as acute myocardial infarction were classified as definite or probable coronary heart disease by the Cornell examiners; but it also indicated that there were a great many employees with asymptomatic or nondisabling forms of coronary heart disease who were not known by the companies to have this disease. More definitive data bearing on the completeness and accuracy of morbidity reporting were obtained by the study of two other companies in the Southeast and Middle West, from which it was possible to obtain complete lists of all sickness absences that occurred during 1964. From these lists one random sample was drawn of all cases that had originally been reported to the company as coronary heart disease, and another random sample was drawn from all other 30-day absences. The samples drawn were of size sufficient to verify at the 95 percent confidence level the estimated proportion of misclassified reports in these two companies. Each absence was investigated by a letter from Cornell to the private physician which was followed by a direct telephone call if this was needed to clear up any ambiguities in the data supplied. The findings (Table 3) indicate that the company reports of "coronary heart disease" are apparently 93 percent (88 to 98 percent) correct and the company reports of "not coronary heart disease" are apparently 100 percent (at least 95 percent) correct when compared with the results of in-

Table 2. Comparison of final classification of 891 male deaths among active employees of the Bell System, 1964.*

Coding by independent registrar	Classification by Cornell reviewers of cases reported to Cornell			Cases not reported to Cornell	Total
	Coronary heart disease (1–6)†	Probable coronary heart disease (11)†	Other (7–10)†		
Rubric 420	300	46	3	36	385
Not Rubric 420	19	0	7	480	506
Totals	319	46	10	516	891

* Male and female deaths during the year totaled 1418. Cornell received death certificates for 1391 (98.1 percent) of these. An independent registrar coded 385 of the 891 male deaths as ICD (International Classification of Diseases) 420 (primary or accessory cause). Cornell received reports of investigations on 349 of the 385 deaths coded ICD 420. Of the other 36 deaths, for which no report of investigation was received by Cornell, 34 had not been recognized as ICD 420 by the company, and reports on the other 2 deaths were not received by Cornell for other reasons. If it is assumed that the coding of the independent registrar is correct and if the ICD 420 cases not reported to Cornell are regarded as "false negatives," the Cornell classification of cases of deaths as "definite" or "probable" coronary heart disease has a specificity of 96.2 percent and a sensitivity of 89.8 percent. See text. † See Table 4.

Table 3. Analysis of reporting of 30-day sickness absences of men in two companies, 1964.*

Report by companies	Total No. of 30-day absences	Direct report of private physician				Percent of erroneous reports by company
		Sample	Not obtainable	Diagnosis: Rubric 420, ICD	Diagnosis: Not Rubric 420, ICD	
Rubric 420, ICD	77	46	4	39	3	7 (2–12%)
Not Rubric 420, ICD	1094	80	10	0	70	0 (0–5%)

* Absences reported by the company as Rubric 420, ICD, were subjected to review and reclassification at Cornell on the basis of the available clinical and diagnostic data (see text and Table 4). Numbers in parentheses include precision margins around the apparent percent, statistically significant at the 95 percent confidence level (*29*).

dependent investigations of sickness-absences based on direct contact with the private physicians and hospitals by the Cornell investigators. As indicated above, absences reported by the company as "coronary heart disease" were subject to review and reclassification at Cornell on the basis of the available clinical and diagnostic data (Table 4).

On the basis of these quality-control studies, it is estimated that the survey data on coronary deaths are at least 91 percent complete, and are accurate within the limits of the clinical and diagnostic capabilities of the physicians who treated these men. The data on disabling events of coronary heart disease are conservatively estimated to include at least 83 percent of all episodes of definite or suspected myocardial infarction that were recognized as such by the private physicians. This estimate is based on the gross number of reports received, with allowance for the probability that there are some companies in which the reporting was less complete or less accurate than in the two companies that were studied. The episodes that have been categorized as "definite" or "probable" coronary heart disease (Categories 1 to 6 and Category 11 in Table 2) are estimated to be essentially correct within the limits of the clinical and diagnostic information required by the APHA-USPHS Princeton Conference Criteria (*15*). These morbidity data, however, include only a small proportion of episodes of angina pectoris and of asymptomatic coronary heart disease, which often do not cause disability and may not be recognized or reported to the company for a varying number of reasons.

No evidence has been found to suggest that there is any significant bias in the reporting of either morbidity or mortality data by the age, education, occupational experiences, or organizational level of the men involved.

Table 4. Events of disability and death among Bell System men reported under Rubric 420 as classified after investigation, 1962–1966.

Rubric 420	First events	Other events	All events: Number	All events: % of total	Deaths included
1. Acute myocardial infarction	1976	617	2593	40.86	354
2. Acute coronary insufficiency or probable myocardial infarction	413	318	731	11.52	5
3. Angina pectoris	218	189	407	6.41	4
4. Otherwise unexplained sudden death in a man with known coronary heart disease	152	361	513	8.08	513
5. Otherwise unexplained sudden death in a man not known to have coronary heart disease	364	15	379	5.97	379
6. Arteriosclerotic heart disease other than above (including old MI)	251	484	735	11.58	221
7. Acute episode of heart disease, nature not clear	42	13	55	0.87	12
8. Pain in chest, nature not clear	57	7	64	1.01	1
9. Heart disease other than coronary heart disease	59	25	84	1.32	17
10. Disease other than heart disease	14	7	21	0.33	6
11. Diagnosis "coronary heart disease" without supporting data	657	104	761	11.99	326
12. Other	3	1	4	0.06	1
Totals	4206	2141	6347	100.00	1839

Source of Social Data

At a central depository in New York there were available data coded and punched on IBM cards, or recorded on magnetic tape, which contained the social and demographic information necessary for other aspects of this study. These included such items as the age, educational history, date of employment, occupational category, present occupational level, and past career of each of the 270,000 male employees in the Bell System. In conjunction with the medical information obtained from the survey, these made it possible to compute rates for morbidity and mortality for various manifestations of coronary heart disease by occupational and social categories, and to investigate possible associations between various social variables and coronary heart disease.

For the purposes of this report the following variables were selected for cross-tabulation against the medical data: (i) the amount and type of education of the subject, (ii) the organizational level of the subject, (iii) the organizational mobility of the subject as measured by the length of time he had been on his present organizational level, (iv) the number of departments in which he had been employed during his career, and (v) the number of companies in the Bell System in which he had served during his career. The purpose of these analyses was to obtain an indication of the past geographic and organizational mobility of the subject, and the amount of education that he had had at the time that he was hired.

This report is based on an analysis of the relationship between these variables and the occurrence of disability and death from coronary heart disease during the 3 years of 1963, 1964, and 1965. The findings from the data for 1962 are concordant with the findings from the data from these 3 years, but because of some difficulty in the retrieval of data from the 1962 employee census, we have preferred to treat the information from the first year of the survey separately. Some of the data from 1966 are still being analyzed. However, there is no reason to believe that these will alter any of the findings described in this report.

During the period of the survey 6347 events of disability and death in the Bell System were reported to Cornell as cases of coronary heart disease. The Cornell classification of these

Table 5. First events of disabling coronary heart disease among Bell System men aged 30 to 59; annual rates per thousand, 1963–1965.*

Level	Function	Rate per 1000		
		All men	No college	College
5–7	Executives	1.85	2.46	1.65
4	General area managers	2.85	5.14	2.07
3	Local area managers	3.91	4.28	3.68
2	Supervisors	3.91	4.17	2.92
1	Foremen	4.52	4.53	4.68
0	Workmen	4.33	4.46	4.15

* Age standardized to U.S. population, white males, aged 30 to 59, 1965 estimate.

cases is shown in Table 4. Cases classified by the reviewers in Categories 1 and 4 (48.94 percent of the total) were regarded as having the most substantial evidence to support the diagnosis. Cases classified in Categories 2, 3, and 5 (23.90 percent of the total) were regarded as having coronary heart disease, but with less substantial evidence to support the diagnosis. Cases in Category 6 (11.58 percent of the total) were regarded as probable coronary heart disease. Those in Category 11 (11.99 percent of the total) were regarded as probable cases of coronary heart disease without supporting evidence. Since the distribution of all of these categories of cases throughout the study population was essentially the same, it has seemed reasonable to treat them all as representing "coronary heart disease" in the sense in which this term is used by physicians throughout the nation to describe a group of common clinical syndromes.

Except where otherwise specified, "coronary deaths" in this report include all deaths in Categories 1 through 6, plus those in Category 11. "First events" in this report are first events known to the company. Some men, especially in Category 4, had been known by their physicians to have coronary heart disease prior to their first acute event of disability or death, but this had not been known to the company. "First disabling events of coronary heart disease" as here reported are those in Categories 1 through 6 and in Category 11. Such events are an indicator of the incidence of disabling coronary heart disease in this population. They are not a direct measure of the total incidence of coronary heart disease, because they do not include first events which are not disabling.

The relation of coronary heart disease to education at time of hire and to level of management attained is shown in Table 5. Age-standardized rates for all men, regardless of education, are highest among workmen and foremen and lowest among managers and executives. However, when the population is divided into two groups based on the amount of education of the men at the time that they were hired, it is clear that the difference between the managers and lower-level men is largely the result of the generally lower rate among college men. Since the proportion of college men increases step by step with each succeeding higher level of the organization (see Table 1), the rates for the men at the higher levels of management are influenced by the greater proportion of college men at those levels.

These data are sufficient to establish that there is not a higher risk of coronary heart disease among the men at the upper levels of management. However, if the effect of education at time of hire is considered, these data do not establish that there is a lower risk among executives and managers. If all of the Bell System male employees are considered to be one population, then supervisors and managers of college background do have fewer events than expected (Table 6); but if one considers the college and the no-college men to be two separate populations, a different conclusion is suggested. One finds that only a small proportion of the college men are at levels 0 to 1, and most of these men are below 40 years of age. There are only 965 college men in the "coronary age range" (40 to 59) who are at levels 0 to 1. The great bulk of college men above the age of 40 are supervisors, managers, and executives. When the college men are considered as one population, the data suggest that college men have a low coronary attack rate in general, but that there is an unexpectedly high rate among the relatively few older college men who have not attained a supervisory level. It is a reasonable assumption that this group of men who have not advanced includes a disproportionate number of men who are in a "high risk" category because of chronic illness. Support for this hypothesis is provided by a previous study of men in an age cohort from the New Jersey Bell Telephone Company (*18*, *19*), in which it was found that men who died of any cause before the age of 60 are likely to have been somewhat less mobile than those who survived.

In general, these data suggest that college men have relatively low rates as compared with no-college men, and that the rates within both groups do not change much from level to level. If there is any exception to this, it indicates a slightly higher rate in the men at lower levels.

The data also indicate that the most upwardly mobile men—the men without college education who have risen to the highest managerial and executive levels of the Bell System organization (levels 4 to 7)—have coronary

Table 6. Observed and expected number of first events of disabling coronary heart disease among Bell System men aged 30 to 59, by level, 1963–1965.

Level	Function	All men			No college			College		
		Man-years at risk	Total events		Man-years at risk	Total events		Man-years at risk	Total events	
			Observed	Expected*		Observed	Expected*		Observed	Expected*
5–7	Executives	3,547	14	22.5	747	4	5.24	2,800	10	13.14
4	General area managers	7,125	26	37.6	2,085	13	13.47	5,040	13	18.20
3	Local area managers	22,601	91	98.1	9,503	50	50.54	13,098	41	35.34
2	Supervisors	75,068	274	315.5	56,943	235	261.04	18,125	39	43.83
1	Foremen and other first level managers	107,728	417	405.4	103,352	403	402.86	4,376	14	9.51
0	Skilled workmen and others not in management	370,195	1,020	962.9	368,026	1,012	983.85	2,169	8	4.98

* In constructing this table the number of events "expected" was calculated by applying the age-specific rates for "all men," for "no-college men," and for "college men," respectively, to the number of men in each of these categories who were at risk at each age, and at each organizational level. Events "observed" and events "expected" are summed across ages. Annual rates computed from these totals cannot be compared because of differences in age distributions in the "college" and "no-college" groups.

Table 7. First coronary events among male managers and executives of the Bell System, analyzed by recency of promotion of the men. The differences between observed (obs.) and expected (exp.) frequencies are not significant ($\chi^2 = 8.78$; d.f. = 15).

Age	Years since last promotion											
	Under 1			1 to 5			5 to 10			10 and over		
	Man-years	Events		Man-years	Events		Man-years	Events		Man-years	Events	
		Obs.	Exp.*		Obs.	Exp.*		Obs.	Exp.*		Obs.	Exp.*
35–39	2162	1	1.71	2614	2	1.69	1231	1	0.57	64	0	0.03
40–44	1934	4	3.62	2960	4	5.53	2610	7	4.81	573	0	1.04
45–49	776	4	3.14	1430	5	5.74	2117	10	8.42	980	2	3.70
50–54	306	3	1.57	653	4	3.24	1185	6	5.92	1251	4	6.27
55–59	389	5	3.99	747	9	7.63	1833	16	18.68	4241	43	42.70
Total	7429	17	14.03	9618	24	23.83	9116	40	38.40	7109	49	53.74

* In constructing this table we calculated "expected" rates by applying the age-specific rates for "college" and "no-college" men to the number of managers of these backgrounds who were at risk in each category, and at each age.

attack rates no higher than those of men of the same age and length of service who have remained as workmen and foremen.

Effect of Promotion and Transfer

Additional evidence on the relation between mobility and coronary heart disease is provided by the age-specific rates for men at various levels (Fig. 1). At all ages from 30 to 65 the rates for managers and executives are slightly lower than those for workmen and foremen. Even the most rapidly promoted men—those who have become managers and executives before the age of 45—have rates no higher than those of workmen and foremen of the same age and length of service.

The effect of promotion has been studied further by examining the coronary attack rates among managers in relation to the amount of time that has passed since they were last promoted (Table 7). In constructing this table, "expected" events were calculated by applying the age-specific rates for college and no-college men to the number of managers of these backgrounds who were at risk in each category and at each age. The events observed and those expected have been found to be in close agreement in every category. Although the managers who have not been promoted for more than 10 years and who are over the age of 60 have somewhat fewer events than expected, it is possible that some managers beyond this age, who have not been promoted for 10 years, and who have disorders such as hypertension or diabetes, may retire voluntarily before the age of 65, as the Company Benefit Plan allows them to do. If a number of such "high-risk men" in this category systematically removed themselves from the population at risk by retiring before the bulk of the healthier men, this could easily account for the occurrence of a few less events than expected at the upper age level in the category of men who have not been promoted for more than 10 years.

A similar analysis has been applied to the data relating to organizational transfers (Tables 8 and 9). Being transferred from one company to another is regarded by many managers as a particularly demanding challenge, since it requires a man to move his family to a new location as well as to cope with a new job in a new company. Being transferred from one department to another is regarded as somewhat less challenging in any single instance, but possibly more demanding overall, since interdepartmental transfers are more common and may occur in more rapid succession. Both types of transfers occur most often in men who are being advanced to a higher level. The result of this analysis is shown in Tables 8 and 9. The number of events observed in men transferred between companies is almost identical with the number expected. The number of events observed in men transferred between departments is somewhat smaller than expected, but the difference is not statistically significant.

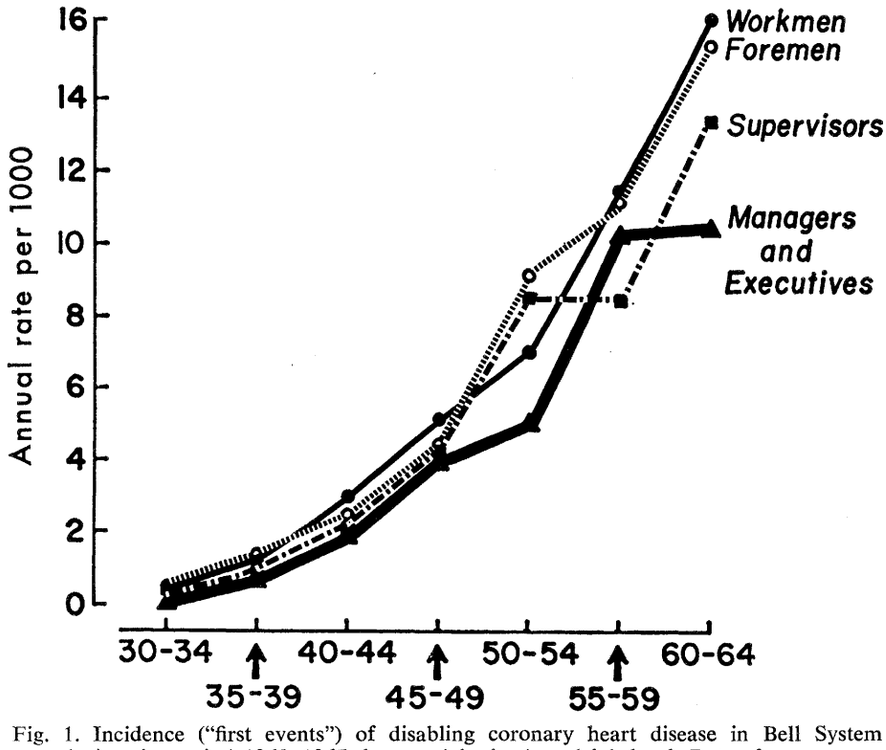

Fig. 1. Incidence ("first events") of disabling coronary heart disease in Bell System men during the period 1963–1965, by age (abscissa) and job level. Rates for managers and executives are consistently lower than those for workmen and foremen. This is true even among the most rapidly promoted men who have attained managerial levels before the age of 40.

Effect of Education

In contrast with this apparent lack of effect of organizational mobility upon the risk of coronary heart disease, there has been a consistent effect of the educational background of the men. The number of new events and deaths that have been observed among college men have been far fewer than would be expected if both college men and no-college men belong to one biological population, having the same risk of coronary heart disease ($P<.005$ and $P<.025$, respectively). The incidence of disabling coronary heart disease has been approximately 30 percent lower among college men than among no-college men under all circumstances. This difference in rate has held true for all indicators of coronary heart disease—for deaths, for first events, and for all events (Fig. 2). With few exceptions, it has held true at all ages (Fig. 2), in all parts of the country (Table 10), and in all departments and job categories for which comparable data have been obtained (Table 11). It has also held true at every level of management above that of supervisor, as we have pointed out in an earlier paragraph. Up to now we have not encountered any exception to this rule which might not be accounted for by the random variation of rates in small subsamples of the population. It is our conclusion that there is a true difference in risk of coronary heart disease between the college and the no-college men, which exists at the time of their employment, and which does not appear to be greatly influenced by subsequent organizational experiences of the type that we have here described.

The results of this survey have provided no indication that adult mobility experiences of the type here described, and the adult behavior that leads to promotion and transfer, have an important adverse influence on the risk of coronary heart disease among men in this population. Men promoted to high levels, men promoted rapidly, men promoted recently, and men transferred to new jobs, to new departments, or to new companies in new geographic areas, have no higher rates of coronary heart disease than comparable men who have not had these experiences. It is possible that men not promoted and not transferred may have a somewhat higher rate; but if this is true it can probably be accounted for by the fact that some men who are chronically ill with conditions that increase the risk of coronary heart disease are not promoted or transferred for reasons of health. We have found evidence for this in another study of men from this population (*19*).

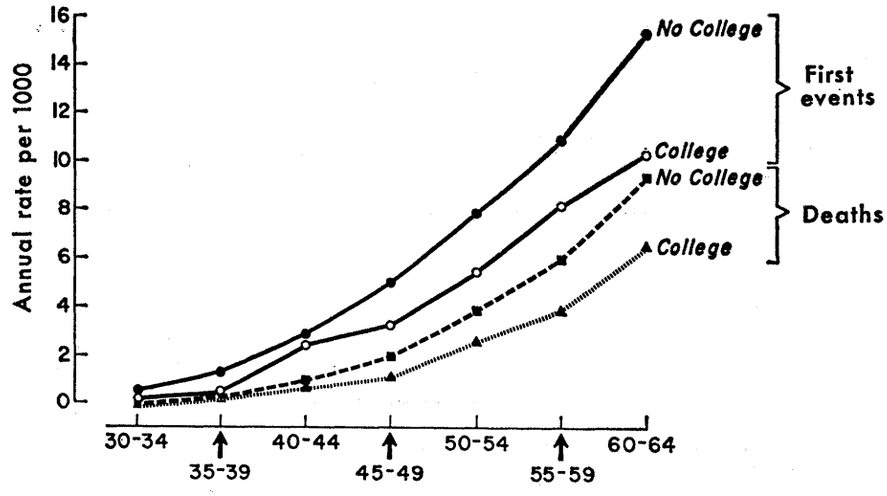

Fig. 2. Incidence of disabling coronary heart disease ("first events") and deaths among men in the Bell System, 1963–1965, by age (abscissa) and education. At every age the rates are lower in the men who had college degrees when they were hired.

We have made a systematic effort to learn why the better-educated men apparently have a lesser risk of coronary heart disease. We have examined the 30-year experiences of an age cohort of 1160 men from the New Jersey Bell Telephone Company (*18*, *19*). We have also carried out intensive examinations of samples of middle-aged men from this company, and of younger men from companies in the

Table 8. First coronary events in male managers and executives of the Bell System, analyzed by departmental transfers. The differences between observed and expected frequencies are not significant ($\chi^2 = 7.45$; d.f. $= 5$).

Age	Service in more than one department			Service in only one department		
	Man-years	Events		Man-years	Events	
		Observed	Expected*		Observed	Expected*
35–39	3,490	1	2.34	2,581	3	1.66
40–44	4,874	7	9.04	3,203	8	5.96
45–49	3,161	9	12.33	2,142	12	8.67
50–54	1,895	10	9.41	1,500	7	7.59
55–59	3,821	33	38.20	3,389	40	34.80
Total	18,962	60	71.32	14,310	70	58.68

* In constructing this table we calculated "expected" rates by applying the age-specific rates for "college" and "no-college" men to the number of managers of these backgrounds who were at risk in each category, and at each age.

Table 9. First coronary events in male managers and executives of the Bell System, analyzed by company transfers. The differences between observed and expected frequencies were not significant ($\chi^2 = 8.73$; d.f. $= 5$).

Age	Service in more than one company			Service in only one company		
	Man-years	Events		Man-years	Events	
		Observed	Expected*		Observed	Expected*
35–39	1,776	2	0.87	4,295	2	3.13
40–44	2,437	7	4.46	5,640	8	10.54
45–49	1,408	4	5.22	3,895	17	15.78
50–54	710	0	3.31	2,685	17	13.69
55–59	1,254	14	12.21	5,956	59	60.79
Total	8,274	27	26.07	24,998	103	103.93

* In constructing this table we calculated "expected" rates by applying the age-specific rates for "college" and "no-college" men to the number of managers of these backgrounds who were at risk in each category, and at each age.

Northeast, Southeast, Middle West, and West. These investigations have included a review of family backgrounds, social origins, previous health experiences, present health status, smoking histories, dietary histories, daily levels of physical activity, daily rounds-of-life, time-oriented purposeful activities, and various indicators of fat and carbohydrate metabolism. We have also carried out a 6-hour monitoring of the electrocardiograms of these men during graded series of activities.

These studies are not yet complete, and the findings are not yet ready for publication. However, it is fair to state that we do find indications that there is a biological basis for the relation between education and risk of coronary heart disease in the Bell System population. Men who had different amounts of education at the time that they were employed appear to have been systematically different in their social and economic backgrounds prior to that time. In association with this they seem to show systematic differences in the size of the families from which they originated, and in the health and longevity of their parents, as well as differences in their own health, their habits and their activities. Some of these differences appear to have persisted throughout their lives.

This has been most clearly reflected in differences in the body-build and in the smoking habits of the two groups of men. We find evidence suggesting that in various parts of the country college men are consistently taller and slimmer than no-college men of the same age and organizational level. We see some reason to believe that this difference in body-build reflects a systematic difference in family background and childhood health, and that it is associated with systematic differences in the eating habits as well as in other aspects of the lives of these men. There also appear to be differences between the two groups in smoking habits. College men apparently begin to smoke later in life, fewer of them smoke cigarettes, and more of them quit. As a result, by the age of 55, the percent of cigarette smokers among no-college men was almost twice that of college men in our New Jersey sample.

We cannot contend that these or any other associations that we are finding in these intensively studied samples necessarily explain the differences in coronary heart disease that have been observed. However, they do indicate that differences in education and level may be associated with meaningful biological differences among the men in the Bell System population. The differences in rates between workmen and managers and the apparent immunity of upper-level managers to coronary heart disease appears to be an unintended result of the process by which men attain advancement. Primarily, it is the result of the fact that a greater proportion of college men attain the upper levels of management; yet preliminary results of the intensive studies suggest that, even among the no-college men, those who are slimmer and better educated, and who have good records of general health and performance, have a greater likelihood of advancing in the organization. Men who become ill or disabled seem to be less likely to move on to higher levels, and those who die of coronary heart disease at lower levels, of course, cannot be promoted. The combination of these factors seems to weed out from the group of potential managers many men with a high risk of coronary heart disease.

Studies of the patterns of daily activity among these men, and of their feelings of pressure and tension in their daily lives, suggest that, in layman's terms, the "stresses and tensions of daily life" are as great for the college men as for the no-college men, and are as great for the workmen as for the managers. On the other hand, the workmen do not seem to be protected by a greater amount of physical activity. In this industry, as in many others, few men do heavy physical labor at the present time, and the difference between the daily caloric expenditures of workmen and managers does not seem to be very great.

Table 10. Age-adjusted* rates per thousand for first coronary events among Bell System men, by geographic area, 1963–1965.

Area	Events (per 1000)	
	No college	College
New England	3.7	4.0
New York	4.7	4.1
New Jersey	4.7	2.6
Pennsylvania	3.6	1.9
Middle Atlantic	4.5	3.9
Southern	5.2	2.1
Midwestern	5.0	4.8
Illinois	5.5	3.3
Plains States	5.3	1.8
Southwest	4.2	1.5
Mountain States	2.6	2.3
Pacific Northwest	4.2	2.5
California	4.0	1.0

* Age standardized to U.S. population, white males, aged 30 to 59, 1965 estimate.

Findings of Others

The findings from this study are in general agreement with those of Lee and Schneider (*20*), who studied men in the oil industry, and those of Pell and D'Alonzo (*21*), who studied men in the chemical industry, and also in general agreement with an earlier study carried out by Mortenson, Stevenson, and Whitney (*22*) in this industry. In all of these studies it was found that men at the highest levels of the organization have less coronary heart disease than men at lower levels. None of these studies lend any support to the idea that organizational advancement, in itself, or high levels of responsibility, in themselves, carry with them any added risk of coronary heart disease.

The earlier studies were different from this one in that they reported a higher rate among foremen and lower-level managers than among upper-level managers. However, these studies did not take into account the possible influence of the background and origins of the men on the risk of coronary heart disease. It seems quite probable that if this had been done some of the lower risk among upper-level men might have been found to be the result of a greater proportion of better-educated men at the upper levels of these industries. It also seems possible that there was a greater difference between the amount of physical activity carried out by workmen and supervisors in the chemical industry at the time of the Pell and D'Alonzo study than there has been in the telephone industry at the time of the present study. This could account for some of the differences in rate between the foremen and workmen reported in this earlier study.

Implications of Our Findings

Perhaps the most important implication of the present data from the Bell System is that there were major determinants of the risk of subsequent coronary heart disease which existed among the men in this population at the time that they were employed as young adults, and which were not greatly altered by their subsequent experiences. This adds to a growing body of evidence that some aspects of the origin of coronary heart disease must be sought for in childhood or adolescence, if not earlier. Since the time of the Korean War there have been repeated reports that pathological evidence of

atherosclerosis can be found not only in young American men, but in American adolescents, and even in children (*23*).

From our studies it seems that the division of the Bell System population on the basis of whether or not the men in it had a college degree at the time that they were hired in their 20's creates two populations with significantly different biological features. The educational process by itself does not seem to account for this. The possession of a college degree at the time of hire, or the lack of one is an important indicator of a difference in social and economic background among men in this population. Social and economic factors had a good deal to do with determining whether a man did or did not have an opportunity to get a college education in the United States in the 1920's and 1930's, when most of the men who are now in the coronary age range in the Bell System were hired. Associated with the social and economic differences in the background of these two groups of men, there appear to have been a great many other factors of biological significance. Some of these seem to have taken the form of habits which have persisted throughout later life. Others may have been the result of various influences on childhood health or nutrition. Constitutional differences seem to be ruled out by the general homogeneity of the study population; but constitutional or genetic differences cannot be excluded on the basis of these data alone.

It is important not to overgeneralize from these observations among Bell System men to social processes and social categories among men throughout the world. In other settings and at other times, other forms of social mobility appear to have quite different consequences, and the meanings of various types of social background may be very different (*24*). For example, there is evidence that intergenerational mobility (*25*), that is, social change from one generation to another, and rural-urban mobility (*26*), may be associated with an increased risk of coronary heart disease among other populations in the United States. On the face of it, this would appear to contradict our finding that mobility among men in a national industrial organization does not increase the risk of coronary heart disease. However, intergenerational mobility and rural-urban mobility involve populations different in social, in economic, and sometimes in ethnic background, from those here described; and both of these forms of mobility may have their most important effect in childhood. Likewise, it has been reported that people at the lower social and economic levels in underdeveloped countries have less coronary heart disease than those at higher levels. This, too, would appear to be contrary to the findings that we and others have reported from samples of the American population (*27*). However, undernutrition is a feature of low economic and social levels in underdeveloped countries, whereas there is evidence that relative overnutrition is greater among Americans at the lower end of the social and economic scale (*28*). The two sets of findings, therefore, may not be in conflict.

Table 11. Coronary events among education and occupational groups of Bell System men; age-adjusted rates per thousand, 1963–1965.*

Occupation	All events (per 1000)		First events (per 1000)	
	No college	College	No college	College
Accounting	6.29	4.80	3.62	3.74
Engineering	6.03	4.04	3.60	2.31
Commercial	6.20	5.50	4.61	3.51
Marketing	7.80	6.16	5.50	4.15
Plant	6.70	5.19	4.48	4.57
Traffic	7.24	4.60	3.29	3.32
Other	6.96	3.82	4.29	2.14
All men	6.62	4.65	4.42	3.10

* Age standardized to U.S. population, white males, aged 30 to 59, 1965 estimate.

Nevertheless, these findings from the Bell System do suggest that organizational mobility and high levels of responsibility during adult life carry with them little if any added risk of coronary heart disease for the bulk of American men who are employed in industries comparable to this one. Our findings do not support the hypothesis that these aspects of adult life in industrial societies are in any large measure responsible for the high prevalence of coronary heart disease in such societies. In this sense they tend to refute a belief that has been widely held by physicians since the days of Osler. They suggest rather that there are important determinants of the risk of coronary heart disease which are already in existence before men reach adult life, and which are not greatly influenced by subsequent experiences or behavior. Some of these determinants appear to be ingrained habits which do not change, but others might be of a more fundamental nature. Our evidence thus lends support to the evidence from a number of recent pathological studies which indicate that the period of growth and development may be very important in the genesis of later coronary heart disease.

Summary

A 5-year prospective survey of the relation between occupation, education, and coronary heart disease has been carried out among the 270,000 men employed by the Bell System throughout the continental United States. The findings indicate that men who attain the highest levels of management as a group do not have a higher risk of coronary heart disease than men who remain at lower levels. The findings provide no evidence that men who have high levels of responsibility, or who have been promoted rapidly, frequently, or recently, or men who are transferred to new departments or to new companies, have any added risk of coronary heart disease. On the other hand, men who enter the organization with a college degree have a lower attack rate, death rate, and disability rate for coronary heart disease at every age, in every part of the country, and in all departments of the organization. The difference in risk appears to exist at the time the men are hired and apparently is not greatly changed by any of the subsequent experiences of the men. We have discussed some of the reasons for believing that this difference in risk is not a result of the educational process itself, but is the result of biological differences between the college and no-college men which are related to, but not necessarily the result of, the differences in social and economic backgrounds from which they originated; some of these differences seem to take the form of habits of eating and smoking, which are formed in childhood and youth and persist during adult life.

References and Notes

1. W. Osler, *Lancet* **1**, 696, 839, 974 (1910).
2. F. Dunbar, *Psychosomatic Diagnosis* (Hoeber, New York, 1943).
3. J. A. Arlow, *Psychosomat. Med.* **7**, 195 (1945).
4. C. Cathey *et al.*, *Am. J. Med. Sci.* **244**, 421 (1962).
5. M. E. Groover, *Trans. Coll. Physicians Philadelphia* **24**, 105 (1957).
6. M. Friedman, R. H. Rosenman, V. Carroll, *Circulation* **17**, 852 (1958).
7. H. I. Russek, *Am. J. Med. Sci.* **243**, 716 (1962).
8. M. Friedman and R. Rosenman, *J. Am. Med. Assoc.* **169**, 1286 (1959).
9. W. I. Wardwell, C. B. Bahnson, H. S. Caron, *J. Health Human Behav.* **4**, 154 (1963).
10. C. D. Jenkins, R. H. Rosenman, M. Friedman, *J. Chronic Diseases* **20**, 371 (1967).

11. R. W. Bortner and R. H. Rosenman, *ibid.*, p. 525.
12. C. B. Bahnson and W. I. Wardwell, *Psychol. Rept.* **10**, 831 (1962).
13. R. H. Rosenman *et al.*, *J. Am. Med. Assoc.* **195**, 130 (1966).
14. M. Friedman *et al.*, *J. Clin. Invest.* **39**, 758 (1960).
15. L. E. Hinkle, *Am. J. Pub. Health* **56**, 1470 (1966).
16. For the purpose of classification, "college" men in this study were defined as men who had a college degree at the time that they were hired; "no-college" men were defined as men who did not have a college degree at the time that they were hired. Most of the "no-college" men had several years of high school education, or were high school graduates, but some had completed part of a college education, and a few had continued their education and had obtained college degrees after their employment.
17. *Epidemiology of Cardiovascular Diseases Methodology*, American Heart Assoc.-National Heart Inst., suppl. to *Am. J. Pub. Health and the Nation's Health* **30**, 10 (1960).
18. L. E. Hinkle, W. N. Christenson, D. S. Ullmann, *Arch. Environ. Health* **13**, 312 (1966).
19. E. W. Lehman, J. Schulman, L. E. Hinkle, *ibid.* **15**, 455 (1967).
20. R. E. Lee and R. E. Schneider, *J. Am. Med. Assoc.* **167**, 1447 (1958).
21. S. Pell and C. A. D'Alonzo, *ibid.* **175**, 463 (1961).
22. J. M. Mortenson, T. T. Stevenson, L. H. Whitney, *Arch. Ind. Health* **19**, 1 (1959).
23. W. F. Enos, J. C. Beyer, R. H. Holmes, *J. Am. Med. Assoc.* **158**, 912 (1955); W. F. Enos, R. H. Holmes, J. C. Beyer, *Am. J. Cardiol.* **9**, 343 (1962); V. C. Roberts, C. Moses, R. H. Wilkens, *Circulation* **20**, 511 (1959); J. P. Strong and H. C. McGill, *Am. J. Pathol.* **40**, 37 (1962).
24. L. E. Hinkle, *Soc. Sci. Med.* **1**, 129 (1967).
25. J. Stamler *et al.*, *J. Chronic Diseases* **11**, 405 (1960).
26. H. A. Tyroler and J. Cassel, *ibid.* **17**, 167 (1964); S. L. Syme *et al.*, *ibid.*, p. 277; T. Smith, *Milbank Mem. Fund Quart.* **45**, 29 (1967).
27. E. W. Lehman, *J. Chronic Diseases* **20**, 381 (1967).
28. P. D. Goldblatt, N. E. Moore, A. J. Stunkard, *J. Am. Med. Assoc.* **192**, 97 (1965).
29. W. G. Cochran, *Sampling Techniques* (Wiley, New York, 1963), p. 75.
30. This is a research report from the Division of Human Ecology of the Departments of Medicine and Psychiatry of Cornell University Medical College, New York, and from the medical departments of the Bell System. The investigations described in this article were supported by PHS grant HE-07796. We thank Professor Amitai Etzioni and Dr. Jay Schulman for their consultations in the course of these studies.

NEWS AND COMMENT

Brandeis Center for Violence Study: Exploring the Causes of Urban Riots

Waltham, Massachusetts. This idyllic suburban setting is an incongruous place for a center devoted to the study of urban violence. The windows of the air-conditioned Lemberg Center for the Study of Violence look out over placid expanses toward wooded hills. Brandeis University is a long way from the heat and passion of the inner city.

Nonetheless, the Lemberg Center is one of the few places where a systematic study is being conducted of the many places where violence occurs. Consequently, whenever turmoil caused by violence breaks out in the nation, the Center is besieged by telephone calls from the press. The main thrust of these inquiries is—"Are we a sick society?"

The Lemberg Center, which has received greater attention after the assassinations of Martin Luther King, Jr., and Robert F. Kennedy, was founded in response to another assassination—that of John F. Kennedy. Shortly after this event, Frank A. Cohen, a New York businessman, offered money to Brandeis for scholarly research on violence; the funds were used to hold three conferences in 1964 and 1965. Because of the interest they generated in the university and elsewhere, it was decided to sponsor a permanent center, which was opened in the autumn of 1965. In 1967, another New York businessman, Samuel Lemberg, gave $1 million as a permanent endowment for the center.

Although the Lemberg Center was founded in response to an act of individual violence against President Kennedy, the focus of its research is on collective violence, particularly race-related urban violence. The Center offers no panaceas or cheerful words to a country increasingly disturbed by riots. The director of the Lemberg Center, John P. Spiegel, a psychoanalyst who formerly taught at Harvard, repeatedly emphasizes that urban riots are not a new phenomenon in American society. He points to the bloody anti-Catholic riots of the 1830's, anti-draft riots of the 1860's, the labor riots of the 1870's, and the anti-Negro riots in the early part of this century. "Nothing that has happened in our cities since 1964," Spiegel says, "comes anywhere near the naked savagery of these previous outbreaks."

The scholars at the Lemberg Center reject what they consider to be a "moral absolutist" position on violence—that of condemning all violence or of supporting it. On several occasions, scholars at the Center have said that only rioting and violence seem to spur the white community to act on the problems of the ghetto.

In an interview, Spiegel offered the following explanation of his view of the study of violence: "I approach the society as a patient having problems. If these problems are explosive, let's face them; only if we face problems realistically can we do something sensible. I try not to put value judgments on violence." Spiegel thinks it would be a mistake to become identified with a particular side in an urban dispute.

In Spiegel's view, "the contemporary ghetto riots grow out of the failure of the civil rights movement in its attempt to achieve normative readjustment for black people through nonviolent protest." He believes that riots, regardless of country or historical period, make a statement calculated to persuade members of the audience to change their behavior. Spiegel thinks that it is necessary to understand and correct the social process by which violence comes about, as well as to understand the pattern of dramatically violent events.

When asked for advice by city leaders, Spiegel replies that he can't do anything to assist with the long-range problems. These problems, he says, are political, revolving around the difficulty of obtaining sufficient money for the cities. The Center, he thinks, can assist only with the immediate problems, by helping bring a certain amount of enlightenment to discussion of the issues. When asked, he tries to help city officials learn about the culture and behavior of the black community; he also warns officials against bragging about their accomplishments on behalf of the ghetto. "Fortunately, we have a good model," he says, "and that's Mayor Lindsay." Although Spiegel does not believe that the leadership of any American city has a fully "sincere recognition" of the problems of the ghetto, he believes that New York City, under Lindsay, has made the most progress toward recognizing what needs to be done.

The Lemberg Center has three purposes: (i) to conduct research on the