Job Decision Latitude, Job Demands, and Cardiovascular Disease: A Prospective Study of Swedish Men

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Abstract: The association between specific job characteristics and subsequent cardiovascular disease was tested using a large random sample of the male working Swedish population. The prospective development of coronary heart disease (CHD) symptoms and signs was analyzed using a multivariate logistic regression technique. Additionally, a case-controlled study was used to analyze all cardiovascular-cerebrovascular (CHD-CVD) deaths during a six-year follow-up. The indicator of CHD symptoms and signs was validated in a six-year prospective study of CHD deaths (standardized mortality ratio 5.0; $p \leq .001$).

A hectic and psychologically demanding job increases the risk of developing CHD symptoms and signs (standardized odds ratio 1.29, $p < .025$) and premature CHD-CVD death (relative risk 4.0, $p < .01$). Low decision latitude—expressed as low intellectual discretion and low personal schedule freedom—is also associated with increased risk of cardiovascular disease. Low intellectual discretion predicts the development of CHD symptoms and signs (SOR 1.44, $p < .01$), while low personal schedule freedom among the majority of workers with the minimum statutory education increases the risk of CHD-CVD death (RR 6.6, $p < .0002$). The associations exist after controlling for age, education, smoking, and overweight. (*Am J Public Health* 1981;71:694–705.)

Recent research indicates that psychosocial stress may be an independent risk factor for the development of coronary heart disease (CHD), although the relative effects of individual and environmental characteristics as determinants of stress-related illness remain unknown.[1-3] In general, psychosocial research on CHD has focused on characteristics of the individual, with less attention devoted to characteristics of the psychosocial environment, particularly at work. Effective health policy must be based on the understanding of both factors.

A logical beginning for investigation of occupation experience would be the macro epidemiological studies of CHD by occupational status (social class groups, income, education). However, the association between status and CHD have generally been considered ambiguous, particularly in studies from the first two decades after World War II.*[4,5] There is evidence that job characteristics may be associated with CHD, independently of the social status measures,[11,12] a phenomenon that may be due to the overly aggregated and unidimensional nature of status measures when used to summarize the health impact of the occupational experience. When detailed measures of job characteristics are examined, positive associations are generally found, but contradictions arise as to the critical factors.[13] Researchers have found associations between CHD and heavy work load,[7,14,15] while others have found CHD related to job dissatisfaction[11, 16] although this evidence is not unanimous.[15] Recent United States findings have further highlighted the need to investigate occupational experience in detail but still fail to provide specific clues as to the risk factors. Haynes, *et al*, recently reported that the pattern of CHD risk factor association differs for white collar and blue collar workers,[3] and that among women it is the clerical workers who have the highest incidence of CHD.[17] Rabkin found especially high rates of myocardial infarction on "back to work" Mondays.[18] Other related research has examined a wide variety of physiological correlates of cardiovascular functioning and found significant job characteristic associations, each within a single occupation: bus drivers,** aircraft executives,[19] air traffic controllers,[20] tax accountants,[21] and auto assembly workers.[22] What seems to be lacking in this research is an integrating theoretical framework for stress-related job characteristics[23] that can be assessed for the full workforce.

We propose a model which postulates that psychological strain, and subsequent physiological illness, result not from an aggregated list of "stressors" but from the interaction of two types of job characteristics. Strain results from the joint effects of the demands of the work situation

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*There is, however, growing evidence to show a negative social class gradient.[6-10]

Editor's Note: See also related editorial, p. 682, this issue.

**Frankenhaeuser M, Rissler A: Personal Communication, July 1979.

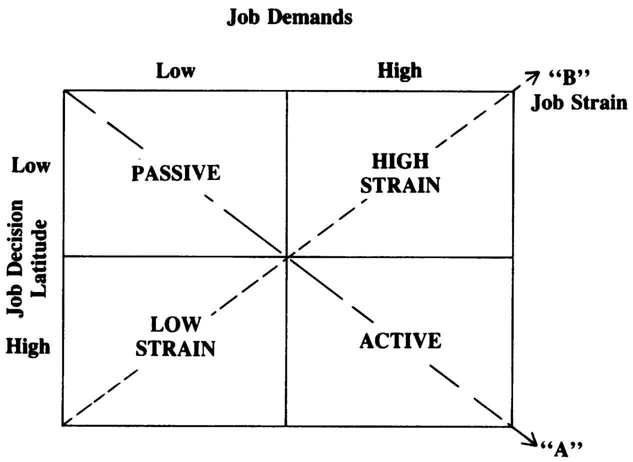


FIGURE 1—Job Strain Model

(stressors) and environmental moderators of stress, particularly*** the range of decision-making freedom (control) available to the worker facing those demands.[25] These two aspects of the job situation represent, respectively, the instigators of action and the constraints on alternative resulting actions. Job demands or stressors place the individual in a motivated state of "stress." If no action can be taken, or if other desires of the individual must be foregone because of low decision latitude, the unreleased stress may have reverse psychological and physiological consequences.[26,27]

Figure 1 summarizes in a simple manner our predictions about the types of jobs that might result from the combination of job demands and decision latitude.[25,28] When demands are high and decision latitude low, we hypothesize that mental strain and increased CHD risk may arise (Diagonal "B").

The empirical association between job characteristics and psychological strain has been demonstrated separately for job demands[21,29,30] and in the case of low decision latitude.[31–35] Recently, the utility of this model of combined effects has been demonstrated in the prediction of mental strain symptoms related to the job, such as depression, sleeping problems, exhaustion, consumption of medication, and dissatisfaction in a variety of studies in the U.S. and Sweden.[25, 35–38‡] Both physiological experiments and field observations in the work place have also shown that a combination of rushed tempo and lack of situational control may be associated with marked blood pressure and heart rate elevations,[19, 22, 31] and particularly so in subjects with Type A (coronary prone) behavior.[39]

***Other moderators, not included in the present study, include social support.[24]

‡a) Jon Turner: Computers in Bank Clerical Functions: Implications for Productivity and the Quality of Life. PhD thesis Columbia University, Department of Industrial Engineering and Operations Research, May 1980.

b) H. J. Freeman, J. Jucker, Stanford University, Department of Industrial Engineering: Comparing Traditional and Innovative Production Organizations. Paper presented at the conference on Current Issues in Productivity, Columbia University, April 18, 1980.

Methods

This study consists of two distinct analyses. First, the association between job characteristics (job demands and two measures of decision latitude) and the prospective development of a CHD indicator is explored using a national random sample of the Swedish male workforce.‡‡ This CHD indicator was validated through a prospective association with CHD and cardiovascular-cerebrovascular deaths. Secondly, a case-controlled analysis was done on the deaths during two follow-up periods (1968–1974, 1974–1977) from cardiovascular or cerebrovascular causes.

The data come from the recent Swedish national Level of Living Surveys in which individuals interviewed in 1968 were reinterviewed in 1974. The Swedish Survey is a random sample of the full adult population (approximately 1:1,000), ages 15 to 75, sampled from a register of all individuals ever born on the 15th of every month or ever immigrated by person number assigned at birth. The data base utilized represents the total working Swedish population in 1968. The random group thus defined was contacted in 1968 and asked to participate in a personal interview. A 92 per cent response rate was obtained. In 1974, the same group was contacted again regardless of whether they had participated in 1968. The response rate obtained in 1974 was 85 per cent of the full sample (augmented to retain age boundaries). The data contain self-reported symptoms of health status and both expert evaluations and self-reports for job content characteristics.[40] The deaths used in the case-control analysis were based on verified death certificates. Sixty-two per cent of the deaths in our sample were autopsied; the accuracy of death certificates is sufficient for the diagnostic categories used.[41]

Our analysis is based upon employed male workers (83 per cent of the work force). Self-employed individuals and farmers were excluded because relevant job descriptions were not obtainable in these groups. The upper age limits were selected in such a way that by the end of the follow-up period subjects were still below traditional retirement age in Sweden (67 years). The number of interviewed subjects fulfilling the age, sex, and employment criteria for the cross-section was 1,915 in 1968 and 1,635 in 1974.‡‡‡ The number of interviewed subjects in 1968 who were asymptomatic and reinterviewed in 1974 was 1,461. The latter subjects were used for the prospective analysis.

‡‡Because the expected incidence of heart-related deaths among the study population during a six-year follow-up would be too few to prospectively demonstrate a direct association between job characteristics and subsequent death, a CHD indicator of higher prevalence and incidence was constructed from self-reported CHD-related symptoms and risk factors.

‡‡‡The 1968 and 1974 cross-sections include many of the same individuals in both years; this group is used in our prospective analysis. However, definition of full cross-sections in 1968 and 1974 to fulfill the age, sex, and employment criteria requires other subjects also: young subjects enter in 1974, and other subjects pass the age boundary.

TABLE 1—Prospective Validation of CHD Indicator[1] 1968–1974 (n = 1928)

Cause at Death	Indicator	Observed Crude Mortality Rate per 100,000/yr.	Standardized Mortality Ratio (Age-Adjusted)	Level of Significance (p)
Cardiovascular-	Present	2412	5.80	<0.001
Cerebrovascular[2]	Absent	180		
CHD[3]	Present	1754	4.98	<0.001
	Absent	152		
All Other Causes	Present	658	1.32	n.s.
	Absent	294		
Total	Present	3070	3.21	<0.001
	Absent	474		

1) Ache in breast, dyspnea, hypertension, heart weakness.
2) ICD codes 400-404, 410-414, 427, 430-438, 440-445.
3) ICD codes 410-414.

CHD Indicator

The CHD indicator was constructed from self-reports of symptoms associated with clinically manifest cardiovascular disease (ache in breast and trouble breathing), self-report of a risk factor (hypertension), and self report of a diagnosis (heart weakness). Blood pressure measurements were not available in the data base. "Heart weakness" is a commonly understood term in Sweden referring to patients with manifest heart disease.

An estimate of reliability of the self-reported variables was assessed by physician reinterview of a random sample of 46 respondents residing in Stockholm shortly after the initial survey interview.[42] A comparison of the two techniques reveals the questionnaire to be an accurate although conservative instrument. For "heart weakness" and hypertension the doctor interview and questionnaire produced almost exactly the same response pattern. For ache in the breast and trouble breathing, however, the questionnaire produced no false positive responses but missed a significant number of mild symptoms reported to the physician. The CHD indicator is based on an additive scale based on these four symptoms, which is then dichotomized at level two (two moderate symptoms or signs or one severe symptom or sign) to form our operational definition of the presence of heart disease. This yields a prevalence rate of 4.1 per cent within our study population (see Appendix).

This CHD indicator was validated in a 5.7 year follow-up using age corrected mortality statistics for all employed male 1968 respondents, age 15 to 74, as shown in Table 1. Expected deaths and standardized mortality ratios (SMRs) were generated using indirect age-adjustment and hypotheses tested by the students' t test. The CHD mortality (ICD codes 410–414) among subjects with the CHD indicator in 1968 was 5.0 times expected ($p < 0.001$) and general atherosclerotic disease, including cardiovascular and cerebrovascular mortality, was 5.8 times expected ($p < .001$). The specificity of the symptoms combination is further confirmed by its lack of association with increased risk for non-atherosclerotic death. The predictive power of this CHD indicator is comparable with that of the London School of Hygiene Questionnaire of the electrocardiogram; not only are the risks of the population identified by our measures as high or higher than those identified by other tests, but the specificity of the CHD identification is clearer than with other tests[42–45] (See Appendix).

Job Characteristics

The "Job Demands" indicator was constructed to measure the aggregate of psychological (not physical) stressors affecting work. Although it does not distinguish specific demands, task pressures are probably the primary source of stress. Buck observed that task is most often cited as the source of stress, even when a wide variety of potential sources were reviewed.[46]

The questionnaire was designed to emphasize reporting on the objective nature of the work, not the reactions of the respondents. Although self-report of a "demanding" job doubtless includes an element of subjective perception of stress,[47] there is also strong evidence of validity for an objective component. Using a similar measure of work load, others have performed occupational level analyses and found distinct clustering of reported work load by occupation, unassociated with subjective measures of strain.[29] Recent analysis of US data using a similar "job demands" measure has revealed significant variation between occupations on analysis of variance* which predicts occupation level psychological strain. Using more detailed measures, Sales found that objective demands were more highly correlated with CHD risk factors than were subjective demands.[48]

The following two questions were utilized for the "job demand" measure:

- Is your job hectic?
- Is your job psychologically demanding?

The following labels were used:

Low (0): Response "no" to both questions.

*Robert A. Karasek, Principal Investigator; Tores Thoerell, MD; Dean Baker, MD, MPH; Frank Marxer, MD: "Job Conditions, Occupation and Coronary Heart Disease", 1980, research sponsored in part by the National Institute for Occupation Safety and Health, Grant No. 1 R01 0H00906-02.

Medium (1): Response "yes" to one question.

High (2): Response "yes" to both questions.

The resulting indicator is a Guttman scale of questions in the order noted above with a coefficient of reproducibility of .94 and a coefficient of scalability of .78.[28]

The content validity of the indicator is confirmed by the fact that known job stressors correlate with it, i.e., piece work and lack of rest breaks.[28] Furthermore, the indicator does not correlate highly with stressors from other spheres of life. The correlations of demanding job with family problems, having small children at home, and "childhood problems," are 0.07, 0.02, and 0.07, respectively. Thus the perception of a hectic or demanding job is not likely to result from associations with non-job stressors.

Job "Decision Latitude" is defined as the working individual's potential control over job-related decision making. Component measures of "Decision Latitude" should differentiate control over use of skill, time allocation, and organizational decisions. The areas available for analysis in the data base include "Personal Schedule Freedom" and "Intellectual Discretion." These measures cover, respectively, whether the individual has control over his time schedule of participation in the work process and, then, whether he can use judgment and assert control over his use of skill within the process itself. While influence over organizational decisions could not be assessed, Intellectual Discretion is highly correlated to broad decision-making authority, r = .55–.60, in other national data bases.[25,49,59]

The "Intellectual Discretion" indicator was constructed from a measure of the skill level required for the worker's job and his response to a question about whether the work is repetitious/monotonous. "Years of training required" is the most often used index to estimate skill level by job analysts.**[51] The question concerning the monotonous/repetitive jobs was included because such jobs, after periods of time, inhibit the opportunity to exercise discretion over skills and, indeed, 79 per cent of the workers reporting repetitive work also had the lowest job skill level. The indicator is very similar in content to measures central in the literature of job alienation, job stress, and job redesign—notably, Kohn's "occupational self-direction,"[52] Gardell's "job qualification" sub-scale,[49] and Hackman and Lawler's variety component of the Motivational Potential Score (MPS).[50]***

The indicator was scored as follows:

Low (0) Repetitive jobs requiring only minimum statutory education.

Medium Low (1) Non-repetitive jobs requiring only minimum statutory education (or repetitive jobs requiring additional formal training—8 per cent of the medium-low responses).

Medium High (2) Non-repetitive jobs requiring at least one to four years additional formal training.

High (3) Non-repetitive jobs requiring more than four years additional formal education.

For each respondent's self-report on intellectual discretion there is also an expert evaluation of job skill requirements. Occupational evaluators at the Swedish Central Statistical Bureau used a 15-category, six-skill level rating scheme designed to measure the "education demanded, assigned, or expected of a particular occupation."[53] The intellectual discretion indicator based on self-report data correlates highly with the expert rating, r = .64 (1968) and r = .69 (1974), which corroborates other findings.[25,50,52,54]

The "Personal Schedule Freedom" indicator is also relatively close in content to other measures used in the job alienation and job design literature, such as Gardell's "job freedom" sub-scale[49] and Hackman and Lawler's "autonomy" scale of the MPS.[50] Further analysis has shown that the questions of this measure are also highly correlated to broad possibilities of control for workers in the primary and manufacturing industries in Sweden in 1968; but they are less successful for that purpose in the service sector industries.[28]

The "Personal Schedule Freedom" measure was derived from three questions:

- Can you make at least one private telephone call during regular working hours?
- Can you receive a private visitor for ten minutes during regular working hours?
- Can you leave your job for half-an-hour for private errands during working hours without telling your supervisor?

The indicator was scored as follows:

Low (0) Response "no" to all three questions.

Medium Low (1) Response "no" to two questions.

Medium High (2) Response "yes" to all questions.

High (3) Response "yes" to all questions.

The resulting indicator is a Guttman scale of questions in the order noted above with a coefficient of reproducibility of .91 and a coefficient of scalability of .64.[28]

Prospective Test of Job Characteristics vs CHD Indicator Development

The prospective CHD indicator development analysis is based upon those men aged 18 to 60 who reported no symptom or sign in 1968 (n = 1,461). A multiple logistic regression technique,[55, 56] developed by Dahlstrom and Dahlstrom, is used.[57] The variables *age, overweight* (self-reported: "none", "some", or "severe"), *current tobacco smoking,*[40] *job demand, intellectual discretion,* and *personal schedule freedom* in 1968 were simultaneously tested with regard to their ability to predict development of a CHD indicator in 1974. The standardized odds ratio (SOR) was calculated for each one of the predictors. This is the change in likelihood of CHD indicator development for each stan-

**This measure must be distinguished from the respondent's actual education and there is clear evidence that the respondents did distinguish between this measure and questions concerning their actual education.[28]

***The following questions were used for the "intellectual discretion" measure:

- Is your job repetitive/monotonous? (1974 and 1968)
- How many years of training beyond minimum statutory education is required by your job? (1974)
- How many years of training beyond minimum statutory education do most workers in your kind of job have? (1968)

dard deviation changed in the predictor.‡ Additionally, the prevalence of the CHD indicator within each demand-decision latitude category was examined for all respondents in 1974 (n = 1,635).

Case-Control Study of Job Characteristics and Cardiovascular-Cerebrovascular Death Risk

Due to small numbers of deaths during the follow-up periods, a prospective cohort study could not be used for analyzing cardiovascular-cerebrovascular risk of death. Therefore, a case-control study was performed based on all cardiovascular-cerebrovascular deaths (ICD codes 400–404, 410–414, 427, 430–436, 440–445). Each case during the periods 1968–1974 and 1974–1977 (n = 22) was identified and blindly matched as closely as possible with three controls for age (±2 years), current tobacco smoking (±5 cigarettes per day), education, and self-reported symptoms of CHD at start of follow-up. As a measure of the association between job characteristics and cardiovascular-cerebrovascular death risk, the estimated relative risk ratio was used. Regarding each case-control quartet as a stratum, hypothesis testing and point estimation were performed according to Mantel and Haenszel.[59] Test-based 95 per cent confidence limits for the odds ratio (OR) were assessed according to Miettinen.[60] The tests were performed for exposure to the dichotomized variables *high demand* (degree 2 vs 0 or 1), *low personal schedule freedom* (0 or 1 vs 2 or 3), and *low intellectual discretion* (0 or 1 vs 2 or 3).

Results

Prospective Study of Symptom Indicator

Table 2 shows the number of respondents and the cross-sectional prevalence of the CHD indicator in 1974 based on job characteristics reported in 1974. In addition, it shows the six-year incidence‡‡ of the CHD indicator in 1974 among those who reported *no* symptoms in 1968 in all demands-decision latitude categories reported in 1968. The overall prevalence of the CHD indicator among respondents (not shown in Table 2) was 4.1 per cent in 1968 and 5.9 per cent in 1974 (5.0 per cent in 1974 for the asymptomatic in 1968). Since there is a slight positive correlation between demands and discretion (r = .27 demands and intellectual discretion; and r = .08 demands and personal schedule freedom) there are somewhat more workers located along the diagonal axis A; however, a substantial number of respondents worked in jobs where demands and decision latitude are not matched[61] along the "strain" diagonal B.

A marked increase in cross-sectional CHD indicator prevalence and a somewhat less marked increase in the six-year incidence are observed along the "strain" diagonal ('B', Figure 1) in Table 2. The cross-sectional prevalence in 1974 increases from 0 per cent in the low demand-high discretion category to 20 per cent in the high demand-low discretion group. The corresponding six-year incidence figures are 0 per cent to 5 per cent. While the increase in the CHD indicator prevalence with increasing demands and decreasing discretion is monotonic in the cross-sectional data, the incidence in the prospective study drops slightly in the extreme "strain" category. The CHD indicator prevalence demonstrates *no* trend along the other diagonal ('A', Figure 1 - where demands and decision latitude are matched). The tabular data for this CHD indicator vs job demands and personal schedule freedom are similar for the cross-sectional prevalence in 1974 but weaker prospectively.‡‡‡

To test the observed trends, a multivariate logistic regression analysis was performed using the presence of the CHD indicator in 1974 as the dependent variable. The independent variables included job demands, intellectual discretion, personal schedule freedom, age, education, overweight, and current tobacco smoking in 1968. The results are presented in Table 3. Significant predictors of the development of the CHD indicator are: older age, high job demands, and low intellectual discretion. Less personal schedule freedom also contributes to the presence of the CHD indicator, but the results do not reach accepted significance levels. Individual risk factors, including education, smoking, and overweight, do not significantly contribute to the development of the CHD indicator.

The correlations among the job characteristics, age, and education are shown in Table 4. Intellectual discretion was moderately correlated with job demands and personal schedule freedom; education was relatively strongly correlated with intellectual discretion and negatively correlated with age. None of the job characteristics was significantly associated with age.

Case-Control Study

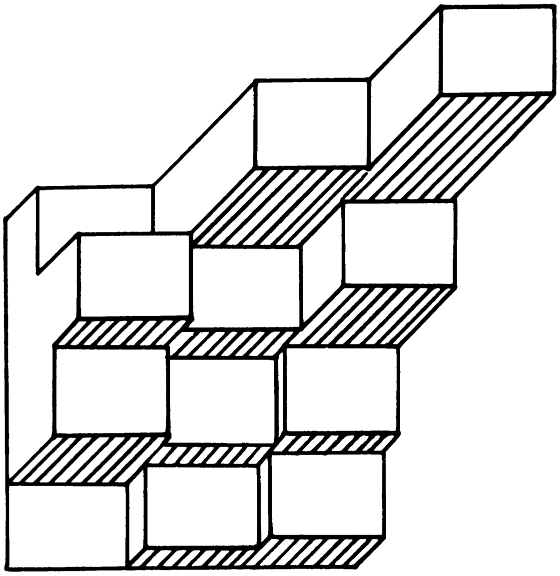
Table 5 shows the results of the cardiovascular-cerebrovascular death case-control analysis. The Table lists the weighted odds ratios for cases and controls who reported high job demands, low intellectual discretion, and/or low personal schedule freedom. For the total sample, the risk of CHD-CVD death is significantly increased for high demands, and for high demands coupled with low schedule freedom. The effects of low intellectual discretion and low

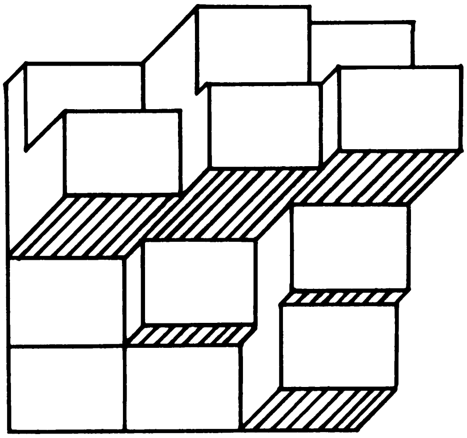
‡The standardized odds ratio = $[_e(\text{logit}_x \cdot \text{standard deviation}_x)]$ allows easy comparison of strength of independent variable effects for (0,1) dependent variables, and allows easy cross survey comparisons if frequency rates are roughly similar (as for CHD). In the Western Collaborative Group Study, the standardized risk ratio was found to be 1.37 for serum cholesterol and 1.37 for Type A Behavior (ages 39–49).[58] In general, a risk ratio of 1.19 could be considered a borderline value for defining a risk factor because it would result in an approximate 2:1 difference in the CHD frequency between groups at the highest and lowest deciles of the risk factor in the population (roughly 3.92 standard deviations separate top and bottom deciles on a variable: $1.19^{3.92} = 2.0$). A risk ratio of 1.42 implies a decile-to-decile difference in CHD frequency of ($1.42^{3.92} = 4.0$): four to one.

‡‡Our incidence rates somewhat underestimate true incidence over the six-year period, since CHD mortalities have been excluded from the CHD indicator analysis.

‡‡‡The marginal cross-sectional prevalences for personal schedule freedom, low to high, are .145, .074, .063, .040 in 1974. The 1974 data, based on 1968 personal schedule freedom, low to high, are: .050, .066, .059, .031.

TABLE 2—Coronary Heart Disease Indicator* 1974 Cross-Sectional Prevalence and Incidence (1968–1974) among Asymptomatic Respondents in 1968, by Job Characteristics: (The Proportion of Employed Males with the Indication of CHD Displayed Graphically as the Vertical Bar by the Job Characteristics of Job Demands and Intellectual Discretion).





Cross-Sectional Prevalence in 1974

Intellectual Discretion \ Job Demands	Low		High	
Low	.032 (63)	.128 (78)	.200 (30)	.105
	.068 (205)	.066 (287)	.104 (144)	.076
	.044 (114)	.040 (202)	.045 (222)	.043
High	.000 (40)	.022 (93)	.028 (143)	.022
	.050	.059	.065	.059 (n=1621)

Incidence 1968–1974**

Intellectual Discretion \ Job Demands	Low		High	
Low	.018 (57)	.069 (116)	.050 (40)	.052
	.050 (219)	.081 (335)	.099 (111)	.074
	.000 (70)	.016 (123)	.045 (111)	.023
High	.000 (36)	.000 (88)	.038 (155)	.022
	.031	.056	.055	.056 (n=1461)

*Ache in breast, dyspnea, hypertension, heart weakness.
**Among those who reported no signs and symptoms in 1968.

personal schedule freedom separately are consistent with the CHD indicator analysis, but do not reach statistical significance. The odds ratio for concurrent low intellectual discretion and high job demands tends towards infinity because there was no exposed control or unexposed case in at least one matched quartet. However the overall odds ratios (aggregates cases, unmatched) show a consistent trend.

The analysis was also performed on a sub-sample with only the minimum statutory education. This group represents 57 per cent of the employed working population in Sweden, but in the older generation represented by the cases and controls in this study, it was 75 per cent. Among this low education population, low personal schedule freedom alone, and low personal schedule freedom with high job demands, are highly significant predictors of CHD-CVD death. Thus the impact of low personal schedule freedom is particularly significant among the workers with low education.

Discussion

Taken together the prospective CHD indicator study and the case control mortality study show consistent results, with some exceptions. Both studies demonstrate that psychologically stressful job demands are associated with subsequent cardiovascular disease. Two measures of low decision latitude on the job are also associated with cardiovascular disease: low intellectual discretion was significantly associated with the CHD indicator, and shows a consistent, but not significant association, in the case-control study; low

TABLE 3—Multivariate Logistic Regression Analysis of Prospective CHD Indicator (Presence of CHD Indicator* in 1974 based on job characteristics and individual risk factors in 1968) (n = 1461)

Variable	Logit	Standard Dev. of Independent Variable	Standardized Odds Ratio	Level of Significance (p ≤)
Age	.065	12.24	2.22	.001
Intelligence Discretion	−.377	.96	1.44	.010
Job Demands	.346	.74	1.29	.025
Personal Schedule Freedom	−.108	.91	1.10	n.s.
Education	−.151	.50	1.08	n.s.
Smoking	.110	.58	1.07	n.s.
Overweight	−.244	.25	1.06	n.s.

*Ache in breast, dyspnea, hypertension, heart weakness.

personal schedule freedom, in combination with high job demands, was significantly associated with CHD in the case-control study, and revealed consistent but not significant associations with the CHD indicator. The effects of job characteristics remain significant after controlling for generally accepted risk factors such as age, smoking, education, and obesity. These findings are consistent with earlier studies which observed an association between either job workload, job skill level, or job decision latitude measures and CHD risk.[7,14,15] Furthermore, the fact that the variables tested here also predict job dissatisfaction indicates the consistency of our results with those which find a significant association between this latter factor and CHD.[11,16]

While our analysis of the CHD risk indicator provides overall support for the job strain hypothesis, there is a slight drop off among the highest "strain" group in the prospective data. This phenomenon is not observed in the cross-sectional analysis, however the cross-sectional and prospective analyses were based upon slightly different populations. The prospective analysis was based upon those who reported no symptoms or signs in 1968 and participated in the re-interview in 1974. Several subjects were lost in the lowest decision latitude category, which had the highest number of deaths during the follow-up interval and a higher non-participation rate in the re-interview phase. Therefore, the subjects in the lowest intellectual discretion category may represent a selected (and more healthy) group. Low educatiton and smoking also affected CHD in the expected directions, but were not statistically significant when job characteristics were simultaneously controlled.

TABLE 4—Correlation between Job Characteristics, Age, and Education in 1968 (n = 1461)

	Intellectual Discretion	Personal Schedule Freedom	Demands	Age
Personal Schedule Freedom	.29			
Job Demands	.27	.08		
Age	−.02	−.02	.13	
Education	.42	.14	.09	−.37

The case-control study should be regarded as a conservative analysis because of factors included in the matching. Ideally, the study should have been based upon subjects who were asymptomatic at the beginning of the follow-up period. However, there were too few deaths among this small group to permit analysis. Therefore, all subjects were included but were then matched on the presence and severity of CHD symptoms and signs. Since blood pressure was included in these CHD symptoms and signs, we almost certainly reduce the association between job characteristics and broad manifestations of cardiovascular illness. Education is correlated with the intellectual discretion measure (r = .42). Thus, matching on this factor could easily obscure any association between low intellectual discretion and CHD-CVD death, and indeed that job measure fails to achieve significance although a positive trend remains. Even with these matching factors (plus age and smoking), high demands and low personal schedule feedom were significantly associated with CHD-CVD death.

Our study differs from many of the major studies in cardiovascular epidemiology in that we do not rely upon tests of CHD morbidity, such as electrocardiogram (ECG) or stress testing to identify our subjects. Instead we examine CHD death using cause of death from death certificates (62 per cent autopsy rate) as a direct indication of CHD-CVD in our case-control study. Our CHD risk indicator is based on signs and symptoms generally conservatively reported. It predicts CHD death as strongly as the London School of Hygiene Angina Scale and ECG monitoring and appears to be a more specific indicator of CHD death than either of those techniques. However, along with other indicators of low prevalence diseases, it is subject to problems of relatively high rates of year-to-year inconsistency, although our rates do not seem unusual (again a bit better than the London Angina Scale) and they decline substantially over age 50. A further issue is that the CHD indicator is a scale rather than an unambiguous 0,1 classification of CHD, and thus classifi-

TABLE 5—Relative Cardiovascular-Cerebrovascular Death Risks Vs Exposure to Dichotomized Job Characteristics Based on Case-Controlled Analysis

	Total Cases (n = 22, controls = 66)		Cases with Minimum Education Only (n = 15, controls = 45)	
	Odds Ratio (95% Confidence Limits)	Level of Significance (p)	Odds Ratio (95% Confidence Limits)	Level of Significance (p)
Low Intellectual Discretion	1.5 (0.4– 5.1)	0.26	1.5 (0.4– 6.3)	0.29
Low Personal Schedule Freedom	1.7 (0.6– 4.7)	0.14	**b	0.0002
High Demand*	4.0 (1.2–13.9)	0.01	3.5 (0.9–13.4)	0.03
Low Personal Schedule Freedom and High Demand	4.0 (1.1–14.4)	0.02	**c	0.0002
Low Intellectual Discretion and High Demand*	**a	—	**d	—

*One case lacks information about this variable.

**Odds ratio tending toward infinity, but could not be calculated because there was no exposed control or unexposed case in at least one subcell, thus not satisfying necessary assumption for risk calculation. Estimates of odds ratios by unmatched analysis were:

a) 6.5
b) 6.6
c) 14.3
d) 6.8

cation changes can occur with changes in symptom severity. While the indicator cannot objectively demonstrate CHD morbidity, its reliability and specificity in the prediction of CHD death are at least comparable to the other indicators of CHD in the literature.[42–44]

The job characteristics measures were derived from questions contained in two consecutive Swedish national surveys. For each measure, the reliability and the validity were demonstrated by consistency with other measures in the job stress literature; and consistency was demonstrated with expert re-evaluations and with statistical analysis. The use of pre-existing data, however, limited the precision of the constructed measures and their congruence with our theoretical constructs.

The psychological job demands measure was designed in the original survey to emphasize objective reporting rather than subjective perceptions, and evidence substantiates this objective component. Nevertheless, elements of subjective perceptions clearly remain, and it would be desirable in future research to have more objective and specific measures concerning task demands.

Intellectual discretion and personal schedule freedom represent two components of our broad construct representing the individual's control over situations in the workplace: job decision latitude. The personal schedule freedom measure is quite specific and correlates highly with other control measures (in the non-service industries).[25,49,50] Areas of decision latitude which could not be covered with available data include overall policy influence and machine pacing. However, these latter factors are highly correlated with the two measures used (particularly intellectual discretion) in other research.[17,37,38] The major component of the intellectual discretion measure, a measure of skill required for the job, is assessed in terms of training required by the job. While necessary training time is a very common scale in job analysis instruments, its use raises the possibility that the individual's actual educational history instead of his job requirement is being measured (indeed the correlation between job measure and the actual education is high). However, strong evidence of the job measure's independent variance is found among the large subpopulation (57 per cent) in Sweden when education is a constant statutory minimum of seven years.* This group has both substantial variance in intellectual discretion and consistent associations between intellectual discretion and CHD (Table 3)[28]. Our analyses also show that the intellectual discretion measure is strongly associated with objective skill assessments in Sweden, and that when job measures and education are simultaneously used to predict CHD in multivariate regressions, the job measures are stronger than the education variable.

Taken together, the intellectual discretion and personal schedule freedom measures probably provide a realistic rough estimate of the employee's broad possibilities for job-related decision-making. However, the intercorrelations between decision latitude variables make it difficult to use such measures for final policy decisions. More detailed measures, with more comprehensive coverage of subcomponents, would be needed before specific job corrective strategies could be undertaken.

*This discrepancy between actual education and utilization of education for the job also affects US workers: the discrepancy scores (high and low together) were 55 per cent, 47 per cent, and 50 per cent in 1969, 1972, and 1977 respectively.[62]

Finally, one must review the possibility that mechanisms other than those we propose account for the associations observed. A "job selection" or "drift" explanation does not appear to be responsible for the findings. The prospective CHD indicator study started with an asymptomatic cohort. The case-control study was specifically matched for reported CHD signs and symptoms. Therefore, the presence of CHD symptoms or signs could not have caused changes in working leading to a spurious association of job characteristics and CHD at a later time. There is also little evidence that more susceptible people happen to work in high strain jobs. Unmeasured biological risk fators such as cholesterol or hypertension would probably not affect individual job choice (at least toward increased risk). Cigarette smoking is measured and is more common in lower status jobs,[63] but simultaneous analysis of smoking with the job characteristics does not diminish the job/CHD associations. Another possibility is that the "disability of background" of lower class workers could constrain them to more hazardous, stressful jobs due to the lack of education or the need for hazard pay. This explanation is not supported by our data since there was a substantial job/CHD co-variation within the major portion of the population (75 per cent) who had the minimum statutory education. Unpublished data show that there is relatively little systematic variation in income among the job categories, except for increasing income in the high demands-high control (executive, professional) category.** Thus among the factors we reviewed, there is no evidence that workers in the high strain category are especially susceptible to CHD.

Furthermore, job changes during the follow-up period cold not have caused the findings. Misclassification due to changes in jobs during the study period should only weaken possible associations. In fact, we have found some evidence that job change out of stressful jobs may have masked even stronger job/CHD associations. Among the subgroup (n = 292) of individuals with no change of job characteristics on either intellectual discretion or psychological job demand (seven point scales) between 1968 and 1974, the prospective job/CHD associations are stronger than in the full population.

Our major conclusion is that low decision latitude or environmental constraints on the worker's ability to decide how to respond to environmental demands appears to be an independent CHD risk factor. This factor resolves a commonly expressed paradox concerning excessive job demands. As Kasl points out in a recent review, "men in higher levels of management frequently have lower rates of CHD."[13] Decision latitude may represent a stress moderating factor with risk-reducing consequences, instead of a job stressor. For many people such latitude may represent a framework of opportunity for coping with stress already present. The risk-reducing advantage of high decision latitude appears to be much more common in high status jobs, and may more than cancel out the moderately elevated rates of psychological job demands in these groups. Such an explanation is clearly consistent with several recent studies of job characteristics and psychological stress symptoms.[19–22] It is constraints on decision-making—not decision-making iself—which appear to pose a new risk factor for psychosocial strain and CHD. While such constraints affect executives and professionals, they are much more common in low status jobs. This explanation is also consistent with several recent epidemiological studies showing an inverse gradient between social class and CHD.[6–10]

The hypotheses posed here, although still rudimentary in formulation, suggest that multiple work environment factors may be involved. Literature in the field of job redesign illustrates that corrective strategies involving these factors are at least available. The work environment factors examined here may also interact in a complex fashion with individually-based psychosocial CHD risk factors, such as Type A behavior. Behavior modification techniques are currently being proposed for reducing CHD risk associated with "stressful" Type A behavior[39] particularly at the workplace. If the work environment is a co-causal factor in these risks or even the generator of such behavior patterns, then it is the work environment which must be the site of initial prevention strategies. These implications of our findings highlight the need for further research to determine the exact association between job situation, psychosocial stress, behavior patterns, and CHD. Certainly the job measures used here can be redefined and clarified in future studies. Ultimately, it may be most important to understand the reasons why job design as currently practiced results in such large numbers of workers with excessive job demands and insufficient job control.

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REFERENCES

1. Rosenman RH, Brand RJ, Jenkins CD, *et al:* Coronary Heart Disease in the Western Collaborative Group Study—Final Follow-Up Experience of 8½ Years. JAMA 1975; 233:872–877.
2. Jenkins CD: Recent evidence supporting psychologic and social risk factors for coronary disease. N Engl J Med 1976; 294:987–994, 1033–1038.
3. Haynes SG, Feinleib M, Kannel WB: The relationship of psychosocial factors to coronary heart disease in the Framingham Study III, eight-year incidence of coronary heart disease. Am J Epidemiol 1980; 111:37–58.
4. Lehman EW: Social class and coronary heart disease: a sociological assessment of the medical literature. J Chron Dis 1967; 20:381–391.
5. Antonovsky A: Social class and the major cardiovascular diseases. J Chron Dis 1968; 21:65–106.

6. Sundbom L: Hjartsjuka 1968–1974: En Studie Av Hjartsjuka I Levnads-nivaundersokeningen; Stencil, Institute for Social Research, Stockholm, 1978.
7. Hinkle LE, Whitney LH, Lehman EW, *et al:* Occupation, education and coronary heart disease. Science 1968; 161:238–246.
8. Pell, S, D'Alonzo CA: Acute myocardial infarction in a large industrial population. JAMA 1963; 185:831–838.
9. Leren P: The Oslo Study: Four Year Mortality and Social Class. Eighth European Congress of Cardiology, Session #SO-89, Paris: Société Française de Cardiologie, June 22–26, 1980.
10. Marmot M: Changing social class distribution of heart disease. Brit Med J 1978; 2:1109–1112.
11. Sales SM, House J: Job dissatisfaction as a possible risk factor in coronary heart disease. J Chron Dis 1971; 23:861–873.
12. Kitagawa EM, Hauser PM: Differential Mortality in the United States: A Study in Socioeconomic Epidemiology. Cambridge, MA: Harvard University Press, 1973.
13. Kasl SV: Epidemiological contributions to the study of work stress. IN: Cooper C, Payne R (eds): Stress at Work. New York: John Wiley and Sons, 1979, pp 3–50.
14. Russek HI, Zohman BL: Relative significance of heredity, diet and occupational stress in coronary heart disease of young adults. Am J Med Sci 1958; 235:266–275.
15. Theorell T, Floderus-Myrhed B: Work load and myocardial infarction—a prospective psychosocial analysis. Int J Epid 1977; 6:17–21.
16. Blohmke M, Schaefer H, Abel H, *et al:* Medizinische und soziale Befunde bei Koronaren Herzkrankheiten. Muchen Med Wschr 1969; 111:701–710.
17. Haynes SG, Feinleib M: Women at work and coronary heart disease: prospective findings from the Framingham Heart Study. Am J Public Health 1980; 70:133–141.
18. Rabkin S, Matthewson F: Chronobiology of cardiac sudden death in men. JAMA 1980; 244:1357–1358.
19. Chadwick J, *et al:* Psychological Job Stress and Coronary Heart Disease. NIOSH Report under Contract No. CDC-99-74-42, 1979.
20. Rose RM, *et al:* Air Traffic Controller Health Change Study. Boston University School of Medicine, report under FFA Contract No. DOT-FA73WA-3211, 1978.
21. Friedman R, Rosenman RH, Carroll V: Changes in serum cholesterol and blood clotting time in men subjected to cyclic variation of occupational stress. Circulation 1958; 17:852–861.
22. Timio M, Pede S, Gentili S: Eliminazione Urinaria Di Adrenalina, Nor Adrenalina E-11-Idrossicorticoidi Nello Stress Occupational. G Ital Cardio 1977; 7:1080–1087.
23. House JS: Occupational stress and coronary heart disease: a review and theoretical integration. J Heath and Soc Behav 1974; 15:12–27.
24. LaRocco J, House J, French J: Social support, occupational stress, and health. J Health and Soc Behav 1980; 21:202–18.
25. Karasek RA: Job demands, job decision latitude, and mental strain: implications for job redesign. Admin Sci Qtrly 1979; 24:285–307.
26. Zeigarnik B: Das Behalten erledigter Handlungen. Psychologische Forsckhung, 1927.
27. Henry J, Cassel J: Psychological factors in essential hypertension, recent epidemiologic and animal experimental evidence. Am J Epid 1969; 90:171–200.
28. Karasek RA: The Impact of the Work Environment on Life Outside the Job. National Technical Information Service No. DLMA 91-25-75-17-11, 1976.
29. Caplan RD, Cobb S, French JRD Jr, *et al:* Job Demands and Worker Health. HEW Pub No (NIOSH) 715-160, Washington, DC, 1975.
30. Quinn RP, Seashore SE, Kahn R, *et al:* Survey of Working Conditions, Final Report on Univariate and Bivariate Tables. Washington, DC: US Dept of Labor, Employment Standards Administration, 1971.
31. Frankenhaeuser M, Rissler A: Effects of punishment on catecholamine release and efficiency in performance. Psychopharmacolgia 1970; 17:378–390.
32. Glass D, Singer JE: Urban Stress: Experiments on Noise and Social Stressors. New York: Academic Press, 1972.
33. Beehr T: Perceived situational moderators of the relationship between subjective role ambiguity and role strain. J Appl Psych 1976; 61:35–40.
34. Maier S, Seligman M: Learned helplessness theory and evidence. J Exp Psycho Gen 1976; 105:3–46.
35. Gardell B: Tjanstemanneens Arbetmiljoer: Psychosocial Arbetsmiljo Och Halso. Preliminar Rapport. Psychologiska Institutionen, Stockholm University, Report No. 24, 1979.
36. Goiten B, Seashore S: Worker Participation: A National Survey Report. Ann Arbor, MI: Survey Research Center, University of Michigan, 1980.
37. Aronssen G: Lokaltrafiken Som Arbetsmiljo Delrapport 1; Arbetsforhallanden Och Halsa. Preliminary Report, Psychological Institutionen, Stockholm University, July 1980.
38. Detzer MM: Presentation on Job Demands in the Bell System to the AT&T Bargaining Committee. Submitted by the Telecommunications Intl Union Bargaining Committee, July 1980.
39. Glass DC: Stress, behavior, patterns, and coronary disease. Amer Scientist 1977; 65:177–187.
40. Johansson S: Om Levnadsnivaundersokningen. Stockholm, Sweden: Laginkomstutredningen, Allmanna Forlaget, 1971.
41. Kannel WB, Dawber TR, Soplie P *et al:* Components of blood pressure and risk of atherothrombotic brain infarction: the Framingham Study. Stroke 1976; 7:327–331.
42. Johansson S: Den Vuxna Befolkningens Halsotillstand. Stockholm, Sweden: Laginkomstutredningen, Allmanna Forlaget, 1976.
43. Rose G: Variability of angina—some implications for epidemiology. Brit J Prev Soc Med 1968; 22:12–15.
44. Higgins ITT, Kannel WB, Dawber TR: The electrocardiogram of epidemiological studies: reproducibility, validity, and international comparison. Brit J Prev Soc Med 1965; 19:53–68.
45. Kreuger DE, Rogot E, Blackwelder WC, *et al:* The predictive value of a postal questionnaire on cardio-respiratory symptoms. J Chron Dis 1970; 23:411–421.
46. Buck VE: Working under Pressure. New York: Crane, Russek, 1972.
47. Lazarus R: Psychological Stress and the Coping Process. New York: McGraw-Hill, 1966.
48. Sales SM: Organizational role as a risk factor in coronary disease. Admin Sci Qtrly 1960; 14:325–336.
49. Gardell B: Produktionsteknik och Arbetsgladje. Stockholm, Sweden: Personaladministrativa Radet
50. Hackman J, Lawler E: Employer reactions to job characteristics. J Appl Psycho Mon 1971; 55:259–286.
51. U.S. Department of Labor: Dictionary of Occupational Titles, Third Ed, Vol II. Washington, DC: US Govt Printing Office, 1965.
52. Kohn M, Schooler C: Occupational experience and psychological functioning—an assessment of reciprocal effects. Am Soc Rev 1973; 38:97–118.
53. Carlsson G, Eriksson RL, Lofwall C, *et ll:* Ekonomiska Grupperinger. Statistisk Tidskrift 1974; 5:381–400.
54. Turner A, Lawrence P: Industrial Jobs and the Worker. Cambridge, MA: Harvard University Press, 1965.
55. Truett J, Cornfield J, Kannel WB: A multivariate analysis of coronary heart disease in Framingham. J Chron Dis 1967; 20:511–524.
56. Brand RJ, Rosenman RH, Sholtz RI, *et al:* Multivariate prediction of coronary heart disease in the Western Collaborative Group Study compared to findings in the Framingham Study. Circulation 53:348–355, 1976.
57. Dahlstrom K, Dahlstrom P: A Program for Multiple Regression When the Dependent Variable is Binary. Department of Statistics, Stockholm University, 1979.
58. Rosenman RH, Brand RJ, Sholtz RI, and Friedman R: Multivariate prediction of coronary heart disease during 8.5 year follow-

up in the Western Collaborative Group Study. Am J Cardiology May 1976; 37:903–910.
59. Mantel K, Haenszel W: Statistical aspects of the analysis of data from retrospective studies of disease. J of Natl Canc Inst 1959; 22:719–748.
60. Miettinen O: Estimability and estimation in case-referent studies. Am J Epidemiol 1976; 103:226–235.
61. McGrath SE: A conceptual formulation for research in stress. IN: McGrath JE (ed): Social and Psychological Factors in Stress. New York: Holt, Rinehart, Winston, 1970, pp 10–21.
62. Quinn RP, Staines GL: The 1977 Quality of Employment Survey. Ann Arbor, MI: Survey Research Center, Institute for Social Research, University of Michigan. 1979.
63. Sterling TD, Weinkam JJ: Smoking characteristics by type of employment. J of Occ Med 1976; 18:743–754.

APPENDIX
A CHD Risk Indicator

Our CHD indicator is a direct indicator of CHD mortality risk but only an indirect measure of CHD morbidity, since it is based on the statistical association of CHD death with self-reported symptoms and signs of CHD, and not with the more commonly utilized direct clinical assessments of CHD morbidity. In Table A-1 we compare the success of our indicator in predicting CHD mortality (based on the use of death certificate information—62 per cent autopsy rate) with other major instruments of the detection of CHD morbidity. These other major instruments include the London School of Hygiene Angina Questionnaire and several ECG studies. The comparison reveals that our indicator has at least as high a relative mortality risk (5.0 $p \leq .001$) as the other techniques, and higher specificity than either the Angina Questionnaire or ECG (1.3 n.s. non-CVD death). It is also useful to note the portion of cases predicted by the indicator. Using the indicator (scale level two), 8 out of 24 CHD (33 per cent) deaths and 11 of 30 CHD-CVD (37 per cent) deaths were predicted over a 5.7 year period. These ratios also compare favorably with the 10 per cent to 27 per cent cited by Rose[43] for a seven-year follow-up of the Angina Questionnaire and ECG cases.

The CHD indicator used in the body of our analysis is based on an additive scale of four self-reports dichotomized at level two (two moderate or one severe), yielding a CHD prevalence rate in rough agreement with other CHD prevalence assessments. Level one of the original scale (one mild) identifies a larger group of the population (11.5 per cent in 1968) than is normally presumed to have clinically diagnosable CHD, but this level of the original scale does identify a larger percentage of CHD-CVD deaths. However, the relative risk ratio is lower than for the CHD indicator (level two of the scale) as would be expected for a less rigorous test (level three and above identify a group too small for practical statistical analysis). Level one predicted 46 per cent of CHD deaths (11 of 24) and 50 per cent of CHD-CVD deaths (15 of 30). The level one mortality risk ratios were 3.1 ($p \leq .005$) for CHD and 3.7 ($p \leq .001$) for CHD-CVD.

Level one of the indicator identifies the group with *any* reported signs and symptoms on our measures and is therefore useful in reviewing the consistency of case identification over time. Inconsistencies may represent either "false positives" or true case status which is not recorded consistently by the measuring instrument. Rose[43] observes that 39 to 45

APPENDIX TABLE A-1—Predictive Power of Symptom and Electrocardiographic (ECG) Indices for Coronary Heart Disease (CHD) among Males Less than 75 Years of Age

Parameter	Composite Indicator in this Study	Rose Study[43]			Higgins Study[44]	Kreuger Study[45]	
Number of Cases	1,928	1,127			2,336	38,249	
Follow-Up Interval (Years)	5.7	7.5			8.0	2.0	
Index of CHD	Symptom Index[a]	Symptom				Symptom	
		Angina[b]	Possible Infarction	ECG[d]	ECG[e]	Angina[b]	Possible Infarction
Relative Mortality Risk–CHD	5.0	3.0[c]	3.5[c]	3.1[c]	2.5[f]	4.8	3.0
Relative Mortality Risk–Non-CHD	1.3				1.7	1.6	1.1
Relative Mortality Risk Ratio (CHD/Non-CHD)	3.8				1.5	3.0	2.7

a) Two or more symptoms: High blood pressure, ache in breast, trouble breathing, heart weakness.
b) London School of Hygiene Angina Questionnaire.
c) Relative CHD Risk includes: CHD mortality, non-fatal myocardial infarction, major angina.
d) Q waves, S-T changes, T wave inversion, conduction abnormalities (Minnesota Code).
e) Q waves, S-T changes, T wave flattened or inversion (Minnesota Code).
f) Aggregated Relative Risk for all ECG abnormalities: observed, expected mortality for sudden, other coronary, non-coronary death.

APPENDIX TABLE A-2—Symptom Consistency Rates

Age (years) 1968	*a* 1974 respondents with any symptoms 1968	*b* subgroup of *a* with any symptoms 1974	b/a
	N	N	%
18–34	40	8	20
35–44	31	15	48
45–49	23	6	26
50–54	15	11	73
55–59	39	24	62
60–66	32	17	53

per cent of the "angina positives" are consistently rediagnosed over a four-year period. In Table A-2, we find that our consistency rates compare favorably, ranging from 20 to 73 per cent (60 per cent average), generally increasing with age. Since incidence also increases at a roughly proportional rate with age, the probability of subsequent symptoms for present symptoms reporters is roughly constant with age. Table A-2 probably overestimates the inconsistency of our indicator over time since no correction has been made for CHD-CVD deaths of individuals who were symptomatic. The level-one indicator used here is also demonstratively less reliable a predictor of CHD (death) than the level-two indicator used for the body of the paper.

COPAFS Establishes Executive Office in Washington, DC

The Council of Professional Associations on Federal Statistics (COPAFS) recently opened an Executive Office at 809 Fifteenth Street, NW, Suite 440, Washington, DC 20005, naming Dr. William H. Shaw as Director and Dr. Marie D. Wann as Chairperson of the Council.

Dr. Shaw, a former Assistant Secretary of Commerce for Economic Affairs and a Past President of the American Statistical Association, has had extensive experience with federal statistics both in and out of the federal government. He was a member of the President's Commission on Federal Statistics 1970–71, and a recent consultant to the President's Statistical Reorganization Project. He has maintained that a high level of integrity for federal statistics is indispensable to the efficient management of the nation's complex economy, noting that over $125 billion of federal, state and local benefits are distributed on the basis of federal population, income, price and unemployment statistics alone.

The Council, which represents 12 professional societies with more than 100,000 members, was organized in response to the desire of those societies to increase their involvement in the key issues affecting the integrity and quality of federal statistics. The American Public Health Association is one of the member societies of the Council. APHA's COPAFS representatives are statisticians Sam Shapiro and Theodore D. Woolsey.

The general objectives of the Council with respect to its 12 member societies are: "to increase the level of information and to encourage discussion of issues of general importance regarding federal statistics as well as to foster development of the capability to respond to these issues." In relation to the government, the Council's objectives are: "to encourage professional relationships with leading statistical personnel, to identify key issues, to obtain current information on developments, to learn about opportunities for improvement, and to monitor the changing situations."

Financial support to the Council is provided by the member associations, and through further funding by the Russell Sage Foundation, the Ford Foundation, the William T. Grant Foundation, as well as individual donors. In establishing the Executive Office in Washington, the Council embarked on a three-year pilot project which will be evaluated in mid-1983 to determine the effectiveness of the Council in meeting its objectives.