Job Characteristics in Relation to the Prevalence of Myocardial Infarction in the US Health Examination Survey (HES) and the Health and Nutrition Examination Survey (HANES)

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Abstract: Associations between psychosocial job characteristics and past myocardial infarction (MI) prevalence for employed males were tested with the Health Examination Survey (HES) 1960–61, N = 2,409, and the Health and Nutrition Examination Survey (HANES) 1971–75, N = 2,424. A new estimation method is used which imputes to census occupation codes, job characteristic information from national surveys of job characteristics (US Department of Labor, Quality of Employment Surveys). Controlling for age, we find that employed males with jobs which are simultaneously low in decision latitude and high in psychological work load (a multiplicative product term isolating 20 per cent of the population) have a higher prevalence of myocardial infarction in both data bases. In a logistic regression analysis, using job measures adjusted for demographic factors and controlling for age, race, education, systolic blood pressure, serum cholesterol, smoking (HANES only), and physical exertion, we find a low decision latitude/high psychological demand multiplicative product term associated with MI in both data bases. Additional multiple logistic regressions show that low decision latitude is associated with increased prevalence of MI in both the HES and the HANES. Psychological workload and physical exertion are significant only in the HANES. (*Am J Public Health* 1988; 78:910–918.)

Introduction

A two-dimensional model of job stress has been shown to be associated with both psychological strain and coronary heart disease in a number of recent studies in the United States and Sweden.[1–7,*] This model postulates that psychological strain and increased cardiovascular risk result not from a single factor, but from the joint effects of the psychological demands of the work situation and the range of decision-making freedom with respect to task organization and skill usage (decision latitude or job control) available to the worker facing those demands. Thus, psychological strain results when individuals have insufficient control over their work situation to be able to satisfactorily deal with the level of demands being placed on them. The present study tests the hypothesis that myocardial infarction (MI) prevalence is greater in high strain jobs than in other jobs.

Most major cardiovascular data sources have collected little or no information on job characteristics for individuals. To overcome this data deficit, we developed a job characteristic estimation system, as described in the previous paper.[8] With indicators of both job conditions and health coexistent in the same data base, tests of hypotheses about the relationship of the two variables were conducted.

*Karasek R: Lower health risk with increased job control among white collar workers, in press, J Organiz Behav 1988.

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Acronyms: Coronary Heart Disease (CHD), Dictionary of Occupational Titles (DOT), US Health Examination Survey (HES), US Health and Nutrition Examination Survey (HANES), Myocardial Infarction (MI), Socio-Economic Status (SES), Standardized Odds Ratio (SOR), United States Public Health Service (USPHS).

Methods

Imputation Method

Job characteristics were estimated for 221 census occupations using the US Department of Labor Quality of Employment Surveys (QES) of the full work force in 1969, 1972, and 1977.[9] We estimate the job characteristics for every person in the HES and HANES using their occupational census code. We accomplish this by the following steps:

- The average score was computed for scales of relevant job characteristics (e.g., decision latitude) for each occupational census code in the QES;
- The occupational census code was identified for every individual's current occupation in the HES and HANES;
- This average QES job characteristic score was assigned to the same occupational census code in the HES and the HANES, e.g., each "baker" on the HES and the HANES is assigned the decision latitude score of the "bakers" in the QES;
- Since other factors available in both data sets (e.g., age) influence a person's decision latitude, these average job characteristic scores were adjusted for each individual in the HES and HANES to reflect their age, race, education, urbanicity, region, and self employment (adjusted mean scores). Thus, because age and decision latitude are positively correlated within occupation, after adjustments, older bakers will have higher scores on decision latitude than will younger bakers (for a full discussion, see previous paper[8]).

The primary determinant of the success of this methodology is the degree to which it captures difference among occupations in job characteristics. In the QES the between-occupation variances of decision latitude and physical exertion are quite high—44.7 per cent and 25.9 per cent, respectively. By contrast, income from the job, known to be related to occupation, has 20.2 per cent of its variance between occupations. However, psychological demands has a low between-occupation variance of 7.1 per cent, limiting its statistical power in the HES and HANES.

Our occupation-based estimation methodology has both advantages and disadvantages over directly measured job data from questionnaires. The fact that job characteristics are imputed should provide a degree of control over self-report response bias which has been considered a major problem in this research area.[10,11] However, our method has the disadvantage of almost certainly underestimating the true strength of associations between myocardial infarction and job characteristics because the method fails to estimate all the variance among individual jobs on the HES and the HANES.

Research Samples

The Health Examination Survey (HES) 1960–62 is based on an examination of a representative sample of 6,672 persons drawn from the civilian, noninstitutionalized population of the United States, ages 18 to 79. The detailed component of the Health and Nutrition Examination Survey (HANES), conducted between 1971 and 1975, is similar to the HES in that it is also representative of noninstitutionalized persons in the United States (6,913 subjects ages 25–74 were examined). Sample weights derived for these surveys are used as appropriate. Both the HES and HANES involve clinical examinations and follow very similar data collection procedures (see HES, HANES documents[12,13] for full description). Our analyses are restricted to males who report current occupation (approximately 17 per cent of the males in each sample are missing occupation data) which results in final sample sizes of 2,409 (2,088 Whites) in the HES, and 2,424 (2,136 Whites) in the HANES. We report results for all males in the body of the text, whereas results for White males only are shown in Appendix Tables 1 and 2. Appendix A illustrates the correlation matrix for the sample of White males for both the HES and HANES.

In the HES data, the presence of myocardial infarction was judged by a clinical panel of four doctors. Myocardial infarctions were classified as definite (93 per cent) or suspect (7 per cent) based on a review of the 12-lead electrocardiograms (EKG), chest X-rays, medical history, and blood chemistry during analyses.[12,14] The presently available HANES data on coronary heart disease (CHD) are based on the diagnosis made by the field examining physicians after reviewing the medical history, the detailed cardiovascular questionnaire, and the complete physical examination. (Chest X-ray and EKG trackings may or may not have been available. An improved classification based on expert EKG evaluation is still in process.) These criteria have probably led to an underestimation of overall myocardial infarction on the HANES. Experience with examining physicians' initial diagnosis compared to final diagnosis with the HES shows relatively few false positive CHD cases but a larger number of false negatives.[14] To reduce the unreliability due to misclassification when angina is included,[13] we decided to focus on that subset of CHD which is most reliably assessed, myocardial infarctions, (ICD codes, 410–414). The number of cases in the HES is 39 (33 Whites) and 30 in the HANES (28 Whites).

Analytic Method

The high job strain population is illustrated in the lower right corner of Figure 1. This figure plots the mean scores of occupations in the QES sample on job decision latitude and psychological job demands.* The high strain occupations[1]—low in decision latitude and high in demands—include many machine-paced or rigidly structured jobs such as assembler, cutting machine operative, and freight handler as well as jobs high in demands with little opportunity for independent action such as cooks and waiters. Executive and professional jobs are excluded because of high decision latitude.[1] Also excluded are some low status jobs with low demands such as janitors and watchmen, as well as jobs relatively low in demands and high in decision latitude such as repairmen, natural scientists, linemen, and some highly skilled craftsmen.

We can parsimoniously operationalize the job strain hypothesis with a single multiplicative product term (an interaction) based on equally weighted scales of psychological job demands and job decision latitude. The top 20 per cent of the occupations on the job strain scale are located to the lower right of the dotted line in Figure 1. The zero point of the scale (at the upper left of Figure 1) is set so that the scale increases monotonically throughout the population.** (The conventional multiplicative interaction term, with zero points at mean scale values, will result in a non-predicted reversal of signs in the middle of the population). We carried out initial analysis of CHD and job strain by comparing CHD rates in the top 20 per cent of the population on the job strain scale to the rest of the population in six age deciles. The Mantel-Haenszel[15] test is applied to the six age cohorts.

Our more comprehensive analyses of the association between the low decision latitude/high psychological demand multiplicative product term and myocardial infarction prevalence utilize the adjusted scores described above in a logistic regression procedure[16,17] applied to all males. The variables that are simultaneously tested with regard to their ability to predict past myocardial infarction are: age, education, race, systolic blood pressure (diastolic blood pressure was too highly correlated with systolic blood pressure to be used simultaneously), average daily cigarette smoking (HANES only), serum cholesterol, and two job variables—the low control/high demand interaction term (defined as above, but not dichotomized) and physical exertion. The conventional risk factors are forced into the equation, but the job variables are included only if $p < .2$. Additional logistic regressions were undertaken using only linear terms*** for job decision latitude, psychological work load, and physical exertion, controlling for the same set of CHD risk factors and demographics listed above. In both analyses, the statistic reported is the standardized odds ratio (SOR) [see Appendix B for details]. Analogous results for the subset of White employed males are reported in Appendix Tables 1 and 2.

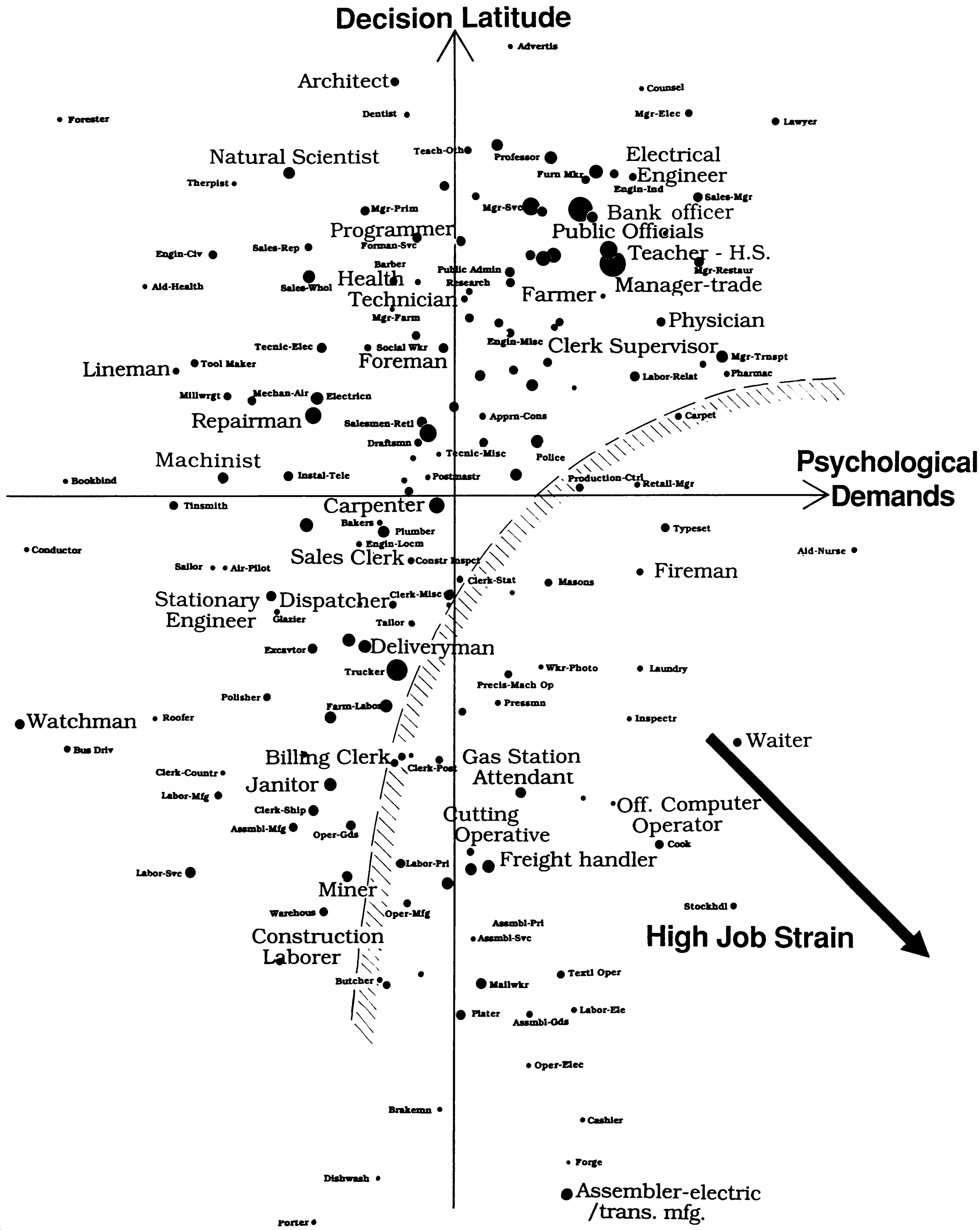
Results

The results of a simple contingency table analysis of the relationship of myocardial infarction prevalence to job strain and age in the two data bases are shown in Figure 2. The HANES survey oversampled some populations. When these analyses were recomputed using appropriate weights, the differences in the answers provided by the weighted and unweighted were insignificant. The unweighted findings are presented in Figure 2 and summarized in the text. Both data bases reveal an elevated prevalence of MI in the "high strain" occupations. In only one age group (45–54, HES) was the prevalence rate less in the "high strain" group. When

*The accuracy of each occupation's coordinate position on the figure varies by occupation sample size (average n = 15) which is indicated by the dot size. Small occupations (the smallest in our sample have n = 3) often have large standard errors (depending also on within-occupation scale score heterogeneity.[8]

**The zero point is set at one standard deviation above the mean on decision latitude, and one standard deviation below the mean on psychological demands.

***Our data are not sufficiently robust to support a conventional interaction test where linear terms are entered simultaneously with the multiplicative term, because of multicolinearity.[18]



*Labels for forty seven occupations could not be printed due to lack of space (computer based label routine).

FIGURE 1—The Occupational Distribution of Psychosocial Job Characteristics
SOURCE: US QES Surveys, 1969, 1972, 1977.
N: 2,897 males

summary measures were computed across the age groups, the estimated odds were 2.48 (chi-square MH = 6.32, p = .012) and 3.28 (chi-square MH = 10.18, p = .001), respectively, for the HES and HANES. Using the overall rate of "high strain" and the estimates of the underlying odds, the estimated attributable risk is .25 and .33, respectively, for the HES and the HANES. While this analysis fails to control for many important factors in myocardial infarction (e.g., race, blood pressure, cholesterol and smoking status), it is striking that controlling for age alone, "job strain" accounts for

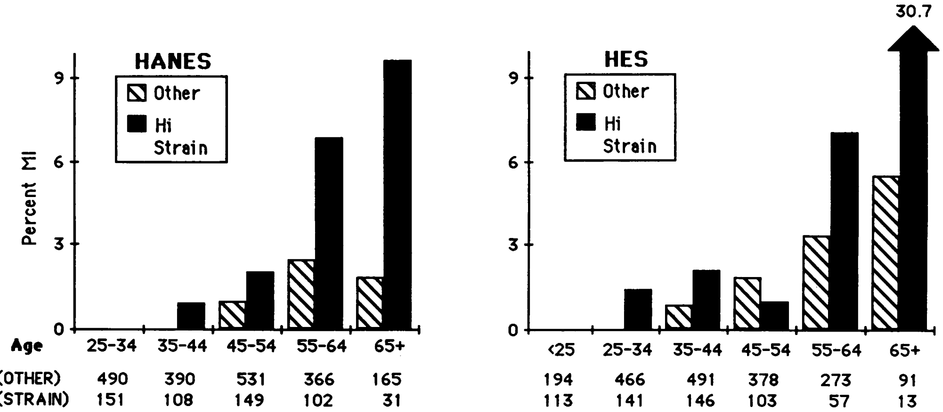


FIGURE 2—Prevalence of Myocardial Infarction by Age and Job Strain, US HANES and HES, Employed Males

between one-fourth and one-third of the MI prevalence in this sample of employed males.

It is also noteworthy that in the HES the percentage of individuals in occupations defined as "high strain" diminishes with increasing age, a phenomenon that is also independently observed in the QES and Health Interview Survey (data not shown). The majority of evidence suggests that individuals move out of "high strain" occupations as they grow older—an important issue for job selection interpretations.

The results of the multivariate analyses simultaneously controlling for other known MI risk factors for males are shown in Table 1 (an equivalent analysis for the subset of White males is presented in Appendix Table 1). As expected, age is the most important correlate of a past myocardial infarction in both data bases. Serum cholesterol is positively correlated with CHD in the HES, but shows only a nonsignificant correlation in the HANES. Information about smoking is available only in the HANES where we observe only a slight positive correlation. Blood pressure has a small and negative association with a past myocardial infarction in both the HES and the HANES, consistent with the results of some other cross-sectional prevalence studies which conclude that blood pressure tends to drop after an individual suffers a heart attack.[19] Race and education have inconsistent relationships to CHD in the two data bases.

The multiplicative low decision latitude/high psychological demand product term remains associated with past MI when used as a continuous variable in both multivariate logistic regression analyses performed with the HES and HANES (SOR = −1.50, 95% CI = −1.07, −2.10 HES; SOR = −1.61, 95% CI; −1.07, −2.41 HANES). What our point estimates indicate is that the relative risk for myocardial infarction for someone in the top decile of job strain compared to someone in the lowest decile is 3.80 in the HES and 4.79 in the HANES (see Appendix B). The relative risk for job strain is on the same order of magnitude as that for smoking or serum cholesterol in other studies.[20,21] Since some of the risk factors which are simultaneously controlled—smoking and serum cholesterol may them-

TABLE 1—Prevalence of Myocardial Infarction in the US Health Examination Survey (HES) and the US Health and Nutrition Examination Survey (HANES): Multivariate Logistic Regression Analysis with Job Demand/Control Interaction Standardized Odds Ratios (SORs), all Employed Males

	HES 1960–62 (N = 2409, 39 Cases)		HANES 1971–75 (N = 2424, 30 Cases)	
Variables	SOR	95% Confidence Interval (p≤)	SOR	95% Confidence Interval (p≤)
Age	4.44	2.85 to 7.49 (.001)	5.27	3.04 to 9.12 (.001)
Race	−1.26	−.92 to −1.76 (.156)	1.21	.75 to 1.96 (.442)
Education	1.35	.97 to 1.88 (.075)	−1.05	−.67 to −1.66 (.828)
Systolic BP	−1.27	−.94 to −1.72 (.115)	−1.45	−.97 to −2.16 (.069)
Cholesterol	1.59	1.19 to 2.13 (.002)	1.17	.81 to 1.63 (.403)
Smoking	**	**	1.23	.88 to 1.73 (.225)
Job				
Low decision latitude/ High demand Product term	−1.50	−1.07 to −2.10 (.017)	−1.61	−1.07 to −2.41 (.022)
Physical Exertion	*	*	−1.38	−.88 to −2.15 (.158)

*Demographic and physiological variables forced into equation. Job variables eliminated if p ≥ .2 (= ns).
**Smoking data not available in HES.

TABLE 2—Prevalence of Myocardial Infarction in the US Health Examination Survey (HES) and US Health and Nutrition Examination Survey (HANES): Multivariate Logistic Regression Analysis with Job Characteristics/Linear Forms, Standardized Odds Ratios (SORs), all Employed Males

Variables	HES 1960–62 (N = 2409, 39 Cases) SOR	HES 1960–62 (N = 2409, 39 Cases) 95% Confidence Interval (p≤)	HANES 1971–75 (N = 2424, 30 Cases) SOR	HANES 1971–75 (N = 2424, 30 Cases) 95% Confidence Interval (p≤)
Age	4.92	2.99 to 8.10 (.001)	7.26	3.78 to 13.90 (.001)
Race	−1.19	−.85 to −1.66 (.307)	1.24	.77 to 2.02 (.376)
Education	1.53	1.05 to 2.22 (.024)	−1.02	−.63 to −1.67 (.929)
Systolic BP	−1.26	−.93 to −1.71 (.133)	−1.46	−.98 to −2.18 (.064)
Cholesterol	1.60	1.20 to 2.14 (.002)	1.20	.84 to 1.73 (.348)
Smoking	**	**	1.23	.87 to 1.75 (.241)
Job				
Decision Latitude	−1.52	−1.02 to −2.25 (.038)	−2.00	−1.39 to −2.87 (.001)
Psychological demands	1.32	.91 to 1.90 (.144)	2.05	1.28 to 3.28 (.003)
Physical Exertion	*	*	−1.47	−.96 to −2.24 (.072)

*Demographic and physiological variables forced into equation. Job variables eliminated if p ≥ .2 (= ns).
**Smoking data not available in HES.

selves be affected by jobs in a manner similar to MI—this model structure probably results in a conservative estimate and test of the *total* relationship of working conditions with CHD. It is noteworthy that the associations are consistent across both data bases and are also observed when simple mean job scores are used for linkage.† Physical exertion on the job, however, is negatively associated with past MI only in the HANES.

The estimates of a linear additive model of the effects of the two job characteristics of interest, i.e., decision latitude and psychological demands, and their relationships to past MI are shown in Table 2. In both data bases, the effects of decision latitude and psychological demands were in the predicted direction: lower decision latitude and higher demands were both associated with higher rates of past MI. Further, all these effects were significant except psychological demands in the HES. The physical demands term was negatively associated with past MI in the HANES only (p = .07).

Discussion

Our primary finding is that analyses of two nationally representative data bases with clinical assessments of cardiovascular illness show that occupations involving low decision latitude and high psychological work load are associated with past MI for male workers. This finding holds both in a simple analysis where a dichotomous strain/nonstrain variable is tested within six age cohorts and in multivariate logistic regression analyses where age, race, education, serum cholesterol, smoking (HANES), and systolic blood pressure were simultaneously controlled. Using the same method of job scoring described herein on a subset of the Framingham cohort, LaCroix found that men exhibited 1.5 times the risk (p = .10) and women 1.4 times the risk (NS) of CHD over a ten-year period when employed in high as compared to low strain occupations.[22]

A potential limitation of the validity of our study's findings is the fact that our results are based on prevalence data. Selection factors can operate to bias prevalence findings and may play a significant role producing spurious positive or negative associations. However, the limitation on drawing causal inferences from prevalence findings depends on the mechanisms involved. For example, as our own findings demonstrate, blood pressure has a negative relationship to CHD in the HES and the HANES—which is contradictory to our understanding of the etiologic relationship between blood pressure and CHD based on prospective cohort studies. This changed relationship is probably the consequence of a fall in blood pressure in individuals as a result of their MI. Furthermore, smoking is discouraged by physicians for MI victims, which may well account for its weaker associations in prevalence studies. Similarly, heavy physical exertion often becomes impossible after an MI. While the occurrence of an MI may change blood pressure, smoking, and physical exertion, the evidence indicates that job decision latitude and job psychological demands are less likely to change in such a way as to account for our findings. In a Swedish study of cardiovascular symptoms, the association between psychological symptoms, job decision latitude, and psychological demands were the same prospectively as they were cross-sectionally.[3] Below we review several other versions of the selection arguments which could affect our prevalence findings.

The first major variant of the traditional "selection" argument is that high strain jobs are a likely haven for the already sick to "drift" into, implying that any observed associations in prevalence are caused by individual job preferences and not the work environment. This factor could

†Use of the simple mean job scores (instead of the adjusted mean scores above) in a similar multivariate logistic regression analysis leads to similar overall magnitudes of estimated effects, however, the estimates are less stable across the four samples, including appendices: (SOR = −1.33, 95% CI = −1.08, −1.64, HES; SOR = −1.72, 95% CI = −1.43, −2.61 HANES; SOR = −1.35, 95% CI = −1.08, −1.69 HES [Whites]; SOR = −1.65, 95% CI = −1.28, −2.14 HANES [Whites]).

be relevant in our study based on current occupation data. The strongest argument against this alternative explanation is that selection *into* high strain jobs is actually highly implausible for at-risk individuals. Empirically, the HES and the combined set of three QES data bases all show relatively fewer occupants of high strain occupations among older age groups (e.g., assembly line workers are predominantly young).[23] This implies selection *out* of these jobs with advancing age. This may be due to the clearly observable psychological strain associated with these jobs. Cardiovascular cases would not be likely to switch into jobs where such clear signals of psychological distress are common. On the contrary, those in our prevalence samples who remain in high strain jobs are likely to be healthy workers—understating true causal effects. Since the most likely target of a job "selection" decision after an MI is a job with lower psychological job demands, and individuals with such jobs are not found to have higher MI prevalence in our study, selection factors seem unable to account for our empirical associations. Selection with respect to decision latitude is highly constrained: individuals are not generally free to select into higher decision latitude jobs (i.e. promote themselves), and they would rarely chose lower decision latitude jobs unless they were accompanied by lower demands. Karasek, *et al*,[3] found that job strain/CHD associations in previously symptom-free patients were even stronger in the subsample which had no job change over a six-year period than they were in the sample that included job changes. This further suggests that selection may reduce our estimate of the causal impact of job strain. There is no proper answer to the selection question without true incidence data.

Another variant of the selection hypothesis is that precareer factors related to class, personality, and genetic background are responsible for the selection of working conditions and predisposition for illness. We agree that this is a possibility and thus we have consistently controlled for social class, as measured by education, in all our multivariate analyses. The fact that education has very little direct effect on CHD prevalence, as shown in Tables 1 and 2, suggests that the hypothesized effect of social class on CHD may actually operate indirectly through the jobs people obtain and the working conditions these jobs entail. This result is inconsistent with the hypothesis that the job strain-CHD relationship is spurious, due to the effects of education on both.

Additionally, there is the possibility that our findings may be due to the effects of differential retirement of the workforce. While we have no direct data on this issue, we can examine the relationship between CHD and educational status among retirees (we would prefer to examine the relationship of CHD to job strain but, unfortunately, the data bases provide no information on occupational title at the time of retirement). The limited data that we have available suggest that selective retirement by strain group cannot account for our findings. In the HANES, among males under the age of 62 with CHD, the four males who were not in the work force had an average education of nine years, while the 23 who remained at work had an average education of 11.2 years. Thus, to the degree that education serves as a proxy measure for job strain and/or socioeconomic status, it would not appear that higher status persons are leaving the work force upon the onset of CHD.

Finally, the possibility of differential mortality by strain group cannot be addressed by the present prevalence data. However, it would seem unlikely that persons in low strain jobs would be more likely to die than persons in high strain jobs as a result of a cardiovascular event. In fact, just the opposite would seem likely. Since, on the average, the non-high strain group is a higher SES category (Duncan score), it would seem more likely that this group would have access to higher quality medical care which would result in lower mortality.

Another version of the predisposition hypothesis asserts that our associations result from risk prone personalities (e.g., Type A persons)[24] selecting stressful jobs and also getting heart attacks. While this is again possible, it is also possible that long-term adverse job experience will lead to a "high anxiety" personality. The hypothesis that working conditions causally influence personality has been convincingly supported, using nonrecursive structural equation models, in the pioneering research of Kohn and Schooler.[25] Also, most studies of Type A behavior have shown that the pattern is more prevalent in high status social groups,[26] making it an unlikely candidate to explain our main association. It is perhaps worth observing, again, that it is not in high status, presumably "success oriented", managerial or professional occupations (where Type A and high incomes are most prevalent) that we record the highest level of CHD. Instead, the peak prevalence occurs in a subset of lower status jobs with high psychological "work load" and low job decision latitude. (Assemblers, inspectors, cutting operatives, garment stitchers, waiters, and cooks would appear to qualify according to their job characteristics, but our samples are not large enough to allow specific occupations to be identified as being at high risk.)

To summarize, our findings must be considered tentative because prevalence data by their nature limit claims of direct causal inference. However, we do not find alternative explanations predicated on job selection mechanisms sufficiently plausible to justify disregarding the finding of a substantial job strain-CHD association. Indeed, we believe that selection mechanisms probably cause us to understate the degree of association.

Our findings from two of the most important US health data bases are consistent with previous incidence and prevalence findings from Sweden,[1-6] and the "low control" findings are also consistent with other recent US data-linkage studies.[27] Why have these associations escaped notice before? The reasons may be the following: The conventional social status scales usually used in occupational research are almost orthogonal to our job strain construct.[28] Furthermore, most occupational studies have been based on single occupations (e.g., air traffic controllers)[29] and this severely restricts job characteristics variance. Also, there have been many studies based on an incomplete model of chronic job stress which fail to differentiate environmental moderating factors from person-based moderating factors.[28]

In Kasl's editorial[11] accompanying our original 1981 publication relating job strain to CHD outcome in Sweden,[3] he challenged us to develop a more reliable and valid instrument for the objective measurement of job strain. In this study, our decision latitude scale, with subscales related to use of skills and task autonomy, is a more clearly defined construct which is more reliable[28] than our earlier measures in a Swedish data base.[3] Both the decision latitude and psychological demands scales are based on a larger number of questions. Given our methodology where an individual's score is based on a summary of all individuals in his/her occupation, self report bias (i.e., subjectivity) is minimized. However, Kasl's challenge to provide more detailed understanding of these two constructs will require still further research. Such research is essential to the etiological understanding of coronary heart disease development and any practical efforts to redesign work to reduce risks.

This research suggests that the social structure of work is correlated with MI. If further research in the US and abroad with stronger designs and more direct assessments of job situations (now underway in the Framingham offspring study and in studies at Cornell Medical Center) confirm these associations, then new perspectives on occupational health and preventive medicine must follow. Those concerned must begin to search for organizational designs that can offer both health *and* productivity. The alternative—to continue to consider productivity as the only goal of work design—would no longer be acceptable. It places employees in the position of having to trade off their health against their economic well-being with uncertain terms of exchange. Other distribution issues are raised by the fact that low decision-making freedom at work is the risk factor most clearly identified here. What levels of hierarchical authority and specialization of labor are healthy? Dialogues on these matters are not impractical: alternative, less rigidly hierarchical work structures have been the subject of decades of experiments by social scientists and managers in Western Europe, Japan, and the US Health professionals have reason to join these discussions.

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APPENDIX A
Correlations, White Employed Males, US HES and HANES Surveys

HES

	Age	Education	Systolic Blood Pressure	Serum Cholesterol	Mean Decision Latitude	Adjusted Decision Latitude	Mean Psychological Demands	Adjusted Psychological Demands
CHD	.1556	.0055	.0459	.0962	.0150	.0259	.0353	−.0494
Age		−.2841	.3962	.3413	.1741	.2175	.0779	−.3688
Education			−.1212	−.0335	.2143	.3276	.1061	.2127
Systolic Blood Pressure				.2224	.0280	.0393	.0265	−.1624
Serum Cholesterol					.1043	.1464	.0559	−.0622
Mean Decision Latitude						.9578	.3846	.2385
Adjusted Decision Latitude							.3932	.2661
Mean Psychological Demands								.8196

(N = 2,088)

HANES

	Age	Education	Systolic Blood Pressure	Serum Cholesterol	Smoking	Mean Decision Latitude	Adjusted Decision Latitude	Mean Psychological Demands	Adjusted Psychological Demands
CHD	.1276	−.0430	.0045	.0384	.0111	−.0536	−.0520	.0169	−.0447
Age		−.3069	.3414	.2245	−.0932	.0003	.0255	.0410	−.4280
Education			−.1407	−.0417	−.0533	.3763	.4545	.1462	.3670
Systolic Blood Pressure				.1490	−.0580	−.0607	−.0515	.0050	−.1654
Serum Cholesterol					.0090	.0521	.0669	−.0018	−.0595
Smoking						−.0819	−.0742	−.0620	−.0150
Mean Decision Latitude							.9645	.3707	.3155
Adjusted Decision Latitude								.3508	.3369
Mean Psychological Demands									.7957

(N = 2,136)

APPENDIX TABLE 1—Prevalence of Myocardial Infarction in the US Health Examination Survey (HES) and US Health and Nutrition Examination Survey (HANES): Multivariate Logistic Regression Analysis with Job Demand/Control Interaction, Standardized Odds Ratios (SORs), Employed White Males

	HES 1960–62 (N = 2088, 33 Cases)		HANES 1971–75 (N = 2136, 28 Cases)	
Variables	SOR	95% Confidence Interval (p≤)	SOR	95% Confidence Interval (p≤)
Age	5.28	3.18 to 8.87 (.001)	5.13	2.86 to 9.28 (.001)
Education	1.40	.99 to 1.98 (.056)	−1.20	−.75 to −1.91 (.445)
Systolic BP	−1.29	−.94 to −1.78 (.154)	−1.46	−.98 to −2.16 (.063)
Cholesterol	1.60	1.17 to 2.19 (.004)	1.23	.85 to 1.78 (.285)
Smoking	**	**	1.28	.92 to 1.79 (.141)
Job				
Low decision latitude/ High demand Product Term	−1.47	−1.05 to −2.05 (.025)	−1.44	−.92 to −2.27 (.114)
Physical Exertion		*	−1.39	−.87 to −2.21 (.161)

*Demographic and physiological variables forced into equation. Job variables eliminated if p ≥ .2 (= ns).
**Smoking data not available in HES.

APPENDIX TABLE 2—Prevalence of Myocardial Infarction in the US Health Examination Survey (HES) and US Health and Nutrition Examination Survey (HANES): Multivariate Logistic Regression Analysis with Job Characteristics/Linear Forms, Standardized Odds Ratios (SORs), Employed White Males

	HES 1960–62 (N = 2088, 33 Cases)		HANES 1971–75 (N = 2136, 28 Cases)	
Variables	SOR	95% Confidence Interval (p≤)	SOR	95% Confidence Interval (p≤)
Age	5.94	3.34 to 10.54 (.001)	7.11	3.37 to 13.90 (.001)
Education	1.56	1.06 to 2.30 (.024)	−1.17	−.71 to −1.91 (.543)
Systolic BP	−1.27	−.92 to −1.74 (.144)	−1.48	−1.00 to −2.20 (.056)
Cholesterol	1.60	1.17 to 2.20 (.003)	1.27	.86 to 1.87 (.234)
Smoking	**	**	1.28	.91 to 1.81 (.160)
Job				
Decision Latitude	−1.45	−1.01 to −2.09 (.091)	−1.89	−1.29 to −2.75 (.001)
Psychological Demands	1.33	.89 to 2.00 (.170)	1.92	1.21 to 2.51 (.008)
Physical Exertion	*	*	−1.50	−.97 to −2.30 (.072)

*Demographic and physiological variables forced into equation. Job variables eliminated if p ≥ .2 (= ns).
**Smoking data not available in HES.

APPENDIX B
Use of Standardized Odds Ratios

Use of coefficients standardized by national population standard deviation units is useful for our psychosocial job scales. Use of such standardized coefficients has been criticized as mixing strength of effect with risk factor distribution information.[18a] However, since our psychosocial scales have no absolute units, no comparison of effect strength can be made on the basis of unstandardized coefficients alone. Such comparisons between scales can, however, be made in the case of our national studies using standardized coefficients because these in effect make the US national population standard deviations the "units" for all scales (we feel this is indeed a useful national reference standard).

The standardized odds ratio (SOR) is calculated using the reported logistic regression coefficient (B) and the standard deviation (S) of the independent variable of interest by the following formula (for negative associations we use a [−] sign instead of using the SOR reciprocal):

$$SOR = e^{BS}.$$

The SOR measures the change in the likelihood (odds) of CHD for each standard deviation change in the independent variable. The estimated bottom decile-to-top decile relative risk (odds) is approximately $SOR^{3.29}$, since, if the data are normally distributed, the medians of these two deciles are respectively 1.645 standardized deviations above and below the mean ($2 \times 1.645 = 3.29$).

ERRATUM

In: Strobino B, et al: Spermicide use and pregnancy outcome. Am J Public Health 1988; 78(3):260–263. In the Introduction, p 260, first paragraph, line 11, the sentence should read: Maternal spermicide use around conception has not been found to be associated with decreased birthweight,[5,10] except in one study[7] where there was a small effect, specific for female infants.