

# The Effects of Psychosocial Work Organization on Patterns of Cigarette Smoking among Male Chemical Plant Employees

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**Abstract:** We tested the hypothesis that job strain (the combination of high psychological job demands and low work control) is positively associated with smoking prevalence and intensity in a study group of 389 males employed in a chemical plant, using a self-administered questionnaire. In a logistic regression analysis which controlled for a number of sociodemographic factors, job

strain was not found to be associated with smoking cessation. However, among smokers, those in higher-strain jobs smoked more heavily than those in lower-strain positions (OR 1.70, 95% CI = 1.10, 2.61) and were more likely to have increased the amount they smoke (OR 3.72, 95% CI = 1.92, 7.17). (*Am J Public Health* 1990; 80:1368-1371.)

## Introduction

Cigarette smoking is a harmful habit, not only in terms of its health consequences but also with respect to its financial impact. Workers who smoke are said to have higher rates of absenteeism, hospitalization, illness, and job-related accidents; each employee who smokes is estimated to cost business \$300 to \$1000 a year.<sup>1</sup> Corporate concern about such facts is indicated by the current proliferation of worksite anti-smoking policies and cessation programs. However, in contrast to the extensive documentation of smoking's effects on employment, the converse of this relationship—how work may influence smoking behavior—remains largely ignored.

Overall, blue-collar workers are much more likely to smoke and less likely to quit smoking.<sup>2</sup> The differential is somewhat smaller for women than for men. While the proportion of persons who have made a serious attempt to quit does not differ substantially between white- and blue-collar workers (64 vs 59 percent, respectively), white-collar workers are more likely to have succeeded (48 vs 35 percent success).<sup>3</sup>

The relation between occupation and smoking may be mediated by the psychosocial work environment. Despite a lack of consistency in definitions and measurement, research has generally found work-related stress to inhibit cessation<sup>4,5</sup> and increase intensity of smoking.<sup>4-7</sup> Workplace social support may affect smoking behavior negatively or positively, depending on the prevalence of smoking and attitudes towards quitting among co-workers.<sup>4,8</sup> In addition, studies of work socialization have indicated that low job control contributes to psychological characteristics such as poor self-esteem and external locus of control,<sup>9,10</sup> which have been associated with a lower likelihood of quitting smoking.<sup>11,12</sup>

Karasek and his colleagues have defined job strain as the combination of high psychological demands with low decision-latitude or control.<sup>13</sup> Research in Sweden and the United States using this model has found high-strain work—where job demands are high and there is little opportunity for control—to be associated with an increased risk of cardiovascular disease (CVD), independent of smoking.<sup>13-18</sup> More

recently, a modified version of this formulation which includes social support has identified a high CVD risk group of strained and socially isolated workers.<sup>19,20</sup> If job stress or strain also increases smoking, it would pose a double risk to cardiovascular health: directly, through physiological mechanisms, and indirectly, through behavioral risk factors such as smoking.

The central hypothesis of the present study was that job strain, defined as a high ratio of psychological demands to control, is negatively associated with smoking cessation and positively associated with both smoking intensity and an increase in smoking over time. A secondary objective was to explore the relationship between workplace social support and smoking behavior.

## Methods

### Study Group

The population surveyed consisted of the approximately 800 employees at a chemical manufacturing plant in the northeastern United States. Two years prior to the study, the plant had established an on-site "Wellness Center," consisting of exercise facilities staffed by two health educators.

Each employee was mailed a copy of the questionnaire described below; after two mailed follow-ups to non-respondents, a final response rate of 60 percent among full-time employees was obtained. From the 466 completed questionnaires, 23 females and 54 males under the age of 40 were excluded, since their work histories were substantially different from those of the majority of the workforce and their numbers too small to allow for meaningful subanalysis. Thus, all analyses were conducted on a study group of 389 male respondents ages 40 and above. The typical study group member was White (93 percent), married (85 percent), and had a high school (51 percent) or more than high school (29 percent) education. Over half of respondents reported earning between \$30,000 and \$40,000 annually.

Non-respondents were less likely than respondents to have registered with the exercise center (28 percent vs 39 percent), and less likely to be salaried (22 percent vs 34 percent) (as opposed to being paid hourly).

Table 1 presents the distribution of job titles in the study group, classified in seven occupational categories. Almost three-fourths were paid on an hourly basis. Half of the group, mostly hourly employees, worked shifts. The average length of time with the company was just over 25 years.

### Questionnaire

The questionnaire collected information on job characteristics, health behavior, and demographics.

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TABLE 1—Distribution of Occupations in Male Study Participants

Occupational Category	N	%
Unskilled workers	26	(6.8)
Semi-skilled workers, machine operators	151	(39.2)
Skilled manual workers	87	(22.6)
Clerks, technicians	74	(19.2)
Administrative personnel, minor professionals	17	(4.4)
Business managers, lesser professionals	18	(4.7)
Higher executives, major professionals	12	(3.1)
No answer	4	
Total	389	

**Job Characteristics:** This section was based on Karasek's Job Content Instrument (JCI),\* with minor modifications. The JCI was designed to measure the content of work tasks in a way which is applicable to all jobs in the United States. Its main focus is the psychological and social structure of work. The six job characteristic scales formed from this questionnaire assess 1) job control, 2) psychological demands, 3) physical demands, 4) job insecurity, and 5-6) social support from co-workers and from supervisors. In addition, a seventh variable measuring job strain was created by dividing the standardized score on the psychological demands scale by the standardized control score. In accord with the job strain hypothesis, the higher the demand/control ratio, the higher the level of strain. (Details of scale content and construction are in the Appendix.)

**Smoking Behavior:** From the questions on smoking behavior, three dichotomous smoking variables were created.

- 1) Smoking cessation (smokers vs ex-smokers);
- 2) Smoking intensity (less vs more than a pack a day);
- 3) Change in smoking habits since starting to work for the company (started smoking or increased amount vs no change or decreased).

#### Statistical Analysis

For the bivariate analyses, simple odds ratios (ORs) measured the strength of the associations, with corresponding 95 percent confidence intervals (95% CIs) calculated using Woolf's method.<sup>21</sup>

Multivariate analysis of the relations between job characteristics, demographic factors, and smoking behavior was conducted. In a logistic regression analysis, a stepwise backward selection procedure was used to determine which of the job characteristics and/or demographic variables were predictors of each smoking behavior variable with the inclusion level set at 0.10.

Standardized ORs (SORs) with 95 percent confidence intervals were computed from the standardized logistic coefficients, following the method proposed by Rosenmann, *et al.*<sup>22</sup> To indicate a negative association, a [-] sign is used, rather than the reciprocal of the SOR. The following variables were initially entered into the logistic model: job strain (demand/control ratio), job insecurity, physical demands, co-worker support, supervisor support, shiftwork (1 = work shifts; 0 = do not), marital status (1 = divorced, 0 = other), education, income, age, and race (1 = White, 0 = other).

\*Job/Heart Project: Job Content Questionnaire and User's Guide, Revision 1.1. New York: Columbia University, March 1985. Unpublished manuscript.

To further examine the relation between job characteristics and behavior, multiple contingency tables were formed by stratifying the data into categories of each of the other variables retained in the logistic model, alone and in combination. From these tables, an estimate of a uniform OR over all strata was calculated using Mantel-Haenszel procedures.<sup>23</sup> The heterogeneity of the ORs across strata was determined by a likelihood ratio test of heterogeneity.<sup>24</sup> Confidence intervals around the Mantel-Haenszel point estimates were then calculated using Miettinen's test-based interval estimation procedure.<sup>25</sup> This analysis produced generally similar results to logistic regression, with all ORs heterogeneous across strata; thus, multiple contingency tables are discussed here only where the stratum-specific ORs are of interest.

#### Results

Almost half (49 percent) of the 389 study participants had quit smoking and 31 percent were current smokers. Half of the former smokers (50 percent) had quit 11 or more years earlier; just over one-third (36 percent) had quit between two and 10 years earlier and 14 percent had quit within the preceding year.

Almost half of the 117 smokers (46 percent) reported smoking more than 20 cigarettes per day; a slightly smaller proportion (41 percent) smoked 10 to 20 a day, and 13 percent smoked fewer than 10. In response to the question of whether their smoking habits had changed since starting to work for this company, 52 percent reported no change, 35 percent an increase, 10 percent a decrease, and 3 percent said they had only begun to smoke since starting to work.

#### Bivariate Analyses

Bivariate analyses found that, as predicted, smokers in high-strain jobs are much more likely to smoke heavily and to report an increase in smoking since starting to work for the company; those in low-strain jobs are also more likely to have quit smoking, although this association is weaker (Table 2).

There is a steady increase in the proportion of heavy smokers as job strain increases. Similarly, the proportion of smokers reporting an increase in smoking grows progressively with increasing job strain. Furthermore, the proportion of smokers who have decreased or maintained their smoking is inversely related to job strain, with a significant number reporting a decrease in smoking only at the lowest level of strain.

#### Multivariate Analyses

Controlling for demographic and other job characteristic variables through logistic regression reduces the association between strain and cessation (Table 3), but the relations between job strain and intensity of smoking and between job strain and increase in smoking remain strong (Tables 4 and 5). In each case, adjusting for the demographic variables remain-

TABLE 2—Bivariate Relations between Smoking Behavior Variables and Job Strain (Low vs High)

Smoking Behavior Variables	Odds Ratio (95% CI)
Cessation (former vs current smokers)	1.71 (0.92, 3.17)
Intensity ( $\leq 20$ cigarettes per day vs $> 20$ )	3.86 (1.35, 10.99)
Change in smoking habits (increased/started vs no change/decreased)	7.78 (2.28, 26.50)

TABLE 3—Smoking Cessation: Variables Retained in Logistic Model

Variables	Standardized Odds Ratio (95% CI)
Age	-1.45 (-1.14, -1.86)
Divorce	1.37 (1.07, 1.75)
Co-worker Support	1.35 (1.05, 1.77)
Job Strain	1.17 (0.90, 1.51)

TABLE 4—Smoking Intensity: Variables Retained in Logistic Model

Variables	Standardized Odds Ratio (95% CI)
Job Strain	1.70 (1.10, 2.61)
Education	-1.61 (-1.05, -2.47)
Income	1.50 (0.97, 2.37)

TABLE 5—Change in Smoking Habits: Variables Retained in Logistic Model

Variables	Standardized Odds Ratio (95% CI)
Job Strain	3.72 (1.92, 7.17)
Age	-2.16 (-1.32, -3.53)
Education	-2.09 (-1.22, -3.55)
Income	1.70 (1.00, 2.89)

ing in the model strengthens the association between job strain and smoking behavior.

The interrelations between smoking cessation, co-worker support, and demographic variables were examined further in multiple contingency table analysis. Overall, co-worker support is negatively associated with having quit smoking. Adjusting the relation between co-worker support and quitting for both education and age reveals some interesting interactions. Co-worker support has little impact on quitting among younger men, regardless of education. Among older men with a high school education or less, co-worker support is associated with smoking (OR 3.13, 95% CI = 1.33, 6.91), while for older men with more education, it is unstably associated with quitting (OR 4.40, 95% CI = 0.82, 20.37).

### Discussion

Our failure to find a relation between job strain and quitting may have been due to the cross-sectional nature of the study: half of the ex-smokers had quit more than 10 years earlier and one-fourth 20 or more years earlier, at which time their job characteristics might have been quite different. Another factor which could affect this association is awareness of occupational exposure to carcinogens. In the 1960s and '70s, a number of workers at this plant had developed lung cancer as a result of their in-plant exposure. Most of the older production workers were at the plant during that time and may have been motivated to quit smoking by the deaths of their co-workers.

As hypothesized, smokers who experience an excess of psychological demands relative to control tend to smoke more heavily and are more likely to report an increase in smoking over time than those in jobs where demands and

control are better balanced. The question on which the association between job strain and increase in smoking is based relied on self-reported assessment of change over a long period of time. Smokers had worked for the company from nine to 42 years, half between 21 and 29 years. However, the accuracy of the report is suggested by the fact that those who reported an increase in smoking were much more likely to smoke over a pack a day (OR 2.81, 95% CI = 1.24, 5.97).

The most important occupational predictor of smoking cessation in this group was co-worker support. While the overall relation is not strong, the stratified analysis by age and education indicates statistical interactions. For older smokers with a high school education or less, strong co-worker support was associated with a lower likelihood of having quit smoking. For those with more education, the opposite is true: those with strong social support were *more* likely to have quit.

The finding that the effect of social support depends on educational level is consistent with the fact that in this study group, smoking was more prevalent among less-educated older men than among those with more education (31 vs 9 percent current smokers, respectively) and that the former were more likely to report that most of the people with whom they spend time do not care whether they smoke, while the latter tended to believe that most people would like them to quit. Other studies also suggest that higher education is associated with more negative attitudes toward smoking.<sup>26</sup> However, a plausible alternative explanation for this finding is that smoking status affects co-worker support: those who work with a group of smokers may fit in better if they also smoke, while being one of a minority of smokers could impair relations with non-smoking co-workers.

If job strain does increase the intensity of smoking, attempts to encourage smokers in high-strain jobs to quit smoking may be hampered by the nature of their work. Thus, modifying job structure so as to increase control and thereby decrease strain could enhance the success of cessation efforts in this population. This recommendation may seem unnecessary and inappropriate if smoking is simply considered a personal behavior controlled by the individual. However, as Syme has pointed out, the systematic patterning of smoking rates in society strongly suggests that social and cultural forces play an important role in this behavior.<sup>26</sup>

## APPENDIX

### Construction of Job Characteristic Scales

#### Control

This scale sums responses to 15 items: six items measure skill discretion (degree to which the job involves learning new things, repetitiveness, creativity, varied tasks, and development of the individual's special abilities), seven items measure decision authority (individual's ability to make decisions about his/her own job, to influence the work group, and to influence company policy), and two items measure closeness of supervision (alpha = .85).

#### Psychological Demands

This scale sums responses to 10 items assessing how fast and how hard the respondent has to work, hectic nature of the job, whether there is enough time to get the job done, frequency of work under time pressure, amount of work and level of concentration required, presence of conflicting demands, and how often tasks are interrupted or work is slowed down by waiting for other people or departments (alpha = .78).

#### Job Insecurity

This scale sums responses to six items: level of job security, prospects for career development and promotion, future value of skills, possibility of lay-off in recent past and near future, and ability to keep up with work (alpha = .69).

**Psychological Demands**

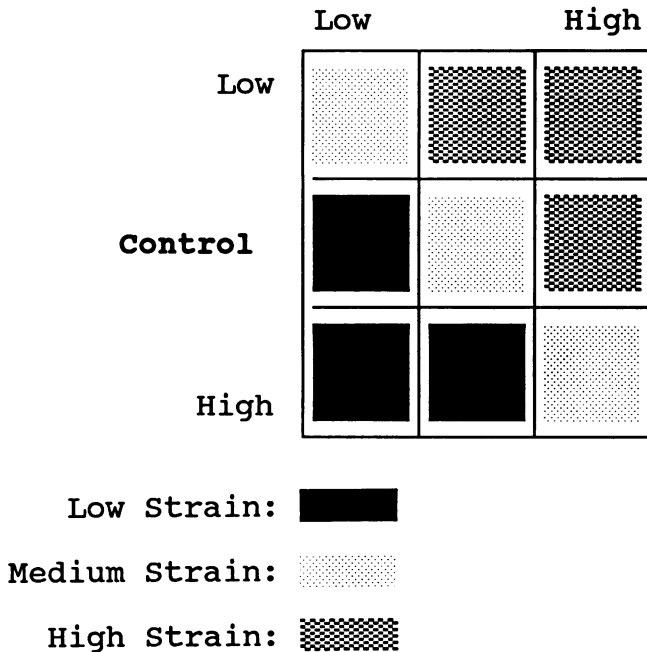


FIGURE 1A—Construction of Three-Level Strain Variable

*Physical Demands*

This scale sums responses to five items measuring physical exertion (degree to which job involves fast and continuous physical activity, intensive physical effort, and lifting) and ergonomic strain (how often body or head and arms must be held in awkward position) (alpha = .91).

*Co-worker Social Support*

This scale sums responses to four items measuring co-workers' competence, helpfulness in getting the job done, friendliness, and degree to which they take a personal interest in the respondent (alpha = .71).

*Supervisor Social Support*

This scale sums five items measuring the supervisor's concern for subordinates' welfare, competence, helpfulness in getting the job done, hostility, and degree to which he/she pays attention to what respondent says (alpha = .84).

Each of these scales was standardized by subtracting the mean from the raw score and dividing the result by the standard deviation; a constant was then added to avoid negative scores. To form contingency tables for bivariate and multivariate analyses, these standardized scores were divided into approximate tertiles (except for the two social support variables which could only be divided roughly at the median, because of their distribution).

*Job Strain*

In addition to the continuous job strain measure (demand/control ratio), a three-level ordinal form was created from a nine-cell matrix constructed from the three levels of control and psychological demands. Each of these nine cells was then classified into one of three levels of strain, based on the Demand-Control Model, which hypothesizes a dimension of strain running diagonally from the lowest level of demands and highest level of control to the opposite extreme (Figure 1A).

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