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Association between job stress and depression among Japanese employees threatened by job loss in a comparison between two complementary job-stress models

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Objectives This study compared the separate effects produced by two complementary stress models — the job demand-control model and the effort-reward imbalance model — on depression among employees threatened by job loss.

Methods A cross-sectional analysis was conducted to examine these associations among 190 male and female employees who responded to a self-administered questionnaire in a small Japanese plant with economic hardship. The employees were engaged in 2 job types — direct assembly line and indirect supportive tasks — and the latter was threatened by job loss because of downsizing. Independent variables were measured by the Japanese versions of Karasek's demand-control questionnaire and Siegrist's effort-reward imbalance questionnaire. Depression was assessed by the Center for Epidemiologic Studies Depression Scale.

Results The employees with indirect supportive tasks (target for downsizing) were more likely to have depressive symptoms than direct assembly-line workers. Job strain, a combination of high demand and low control at work, was more frequent among the latter, while the combination of high effort and low reward was more frequent among the former. After adjustment for work environment factors, low control [odds ratio (OR) 4.7], effort reward imbalance (OR 4.1), and overcommitment (the person characteristic included in the effort-reward imbalance model) (OR 2.6) were independently related to depression. There is some indication that these effects were particularly strong in the subgroup suffering from potential job loss.

Conclusions This study confirms that the 2 job stress models identify different aspects of stressful job conditions. Moreover, effort-reward imbalance and low control at work are both associated with symptoms of depression.

Key terms job insecurity, job-stress models, psychological stress, work.

The attention given job stress has grown as increasing evidence of its role in occupational health has become available (1, 2). In particular, studies using theoretical models of job stress have proved to be useful as they identify specific components of the work environment, or the interaction between the work setting and the worker, which adversely affect health.

Two such models have received special attention in recent years, the job demand-control (JDC) model (3—5) and the model of effort-reward imbalance (ERI) (6, 7). The JDC model consists of two orthogonal components, psychological demands and job control, the latter being defined by the two subscales skill discretion and decision authority. The JDC model posits that a combination of high demand and low control is particularly likely to elicit adverse health effects at work (3, 4). Although the combined effect of the demand and control components is of central interest to this model, its single components may also predict stress-related health outcomes. There is evidence for both combined

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(2, 5) and separate (especially low control) effects (1, 2, 8). More recently it was suggested that the explanatory significance of the components of the model may vary according to the health criteria under study. As the JDC model focuses on aspects of the workplace and work organization, it offers promising opportunities for theory-based intervention.

The ERI model differs from the JDC model in 2 important respects. First, it emphasizes reward rather than control; thus it includes features of the labor market (salary, promotion prospects, job security) in addition to workplace-related features. In particular, deviation from a socially approved exchange process in which efforts spent at work are compensated by adequate rewards is considered highly stressful as it undermines a sense of reciprocity and fairness (7, 9). Hence a mismatch between high efforts and low rewards at work (ratio of effort-reward imbalance) defines the stress-provoking component, especially so for employees who have no alternative choice in the labor market. A second difference between the ERI and the JDC models concerns the former's inclusion of a personal (intrinsic) component into an otherwise situational model of job stress. As part of the ERI model, a distinct personal style of coping with job demands termed "overcommitment" has been specified. Overcommitment defines a set of attitudes, behaviors, and emotions reflecting excessive striving in combination with a strong desire of being approved and esteemed. People characterized by overcommitment exaggerate their efforts beyond levels normally considered appropriate. In summary, the ERI model incorporates 2 sources of information, situational (extrinsic) and personal (intrinsic), to assess stressful experience at work in a more comprehensive way. This model has been shown to predict several health outcomes among economically active populations, mostly cardiovascular, musculoskeletal, and mental health. (For a review, see references 1, 2, and 9.)

This paper compares the 2 models of job stress with respect to an epidemiologically relevant health condition, depression (10). Our first question was "Is there an association between stressful psychosocial work conditions and reduced mental health (in particular depression)?" The additional question was "Do the 2 models measure stressful psychosocial work conditions equally well in explaining the prevalence of depression?" While one previous investigation has already demonstrated a direct effect of effort-reward imbalance, as well as high demands and low control, on psychiatric disorder (mainly depression) (11), our study offers a unique opportunity to analyze this association in a context of actual threat of job loss. While actual experience of job loss (12) and anticipation of redundancy (13—16) were shown to be related to worsening health, including depression, no study has yet, to our knowledge, tested the association between anticipated job loss and depression in the context of a theoretical model. In the ERI model, included in our analyses, job insecurity is one of 3 indicators of low occupational rewards. Thus we maintain that exposure to a threatening context acts as a modifier of the effect of effort-reward imbalance on depression.

Subjects and methods

Subjects

The investigation was conducted in July 1999. The target population included 213 male and female full-time workers of a small production plant in a Japanese town. This plant had a subcontract with a huge automobile-producing factory, and this subcontract concerned the production of electric equipment. The employees were engaged in 2 types of jobs. Those labeled "direct members" worked on the production assembly line, and those labeled "indirect members" were assigned supportive tasks (eg, supplementation of materials and clerical tasks). At the time of the study, the latter group, the indirect members, was threatened by job loss as the plant management aimed at reducing its size by more than half, and about one-fifth of the group had already left the plant. A total of 190 (89%) employees participated in this study. The small group of nonrespondents did not differ from the respondents in terms of age, gender, or type of job. Therefore, the information included in our study can be considered representative of the total workforce of this plant. The unusually high participation rate may have been due to the severe economic crisis that hit the plant at the time of the data collection.

Measures

A self-administered questionnaire was distributed, together with explanatory and motivational information on the study. Informed consent was obtained from all the participants.

Five scales were used for job stress measures in this study, 2 scales related to the JDC model and 3 scales related to the ERI model. The Japanese version of the JDC [the MONICA psychosocial optional study protocol (17) of the World Health Organization], the psychometric properties of which have been reported elsewhere (18, 19), contains a scale measuring psychological demands (5 items) and a scale measuring job control, composed of the 2 subscales "skill discretion" (4 items) and "decision authority" (2 items). All the statements are Likert-scaled items scored according to frequency. In the total sample Cronbach's alpha was 0.79 for the scale

"psychological demand" and 0.80 for the scale "job control". In order to test Karasek's original hypothesis (3), a 3rd "strain" measure was constructed out of the 2 scales. To this end, the scores for psychological demand and job control, respectively, were dichotomized at the median to define a high demand-low control group [subjects scoring above the median of the demand scale and below the median of the control scale, the so-called quadrant model (20, 21)]. Thus a "strain group" was operationally defined, as was a "nonstrain group", and it was hypothesized that the former would have a higher risk of depression.

The standardized self-administered questionnaire measuring the ERI model (6, 22) has been translated into Japanese, and its psychometric properties have been tested more recently (Tsutsumi et al, unpublished manuscript). Two summary measures were constructed to test the model. The 1st is a ratio of the sum score of items measuring "effort" (6 items) and the sum score of the items measuring "reward" (11 items) according to test statistical instructions (22). Only items with a prevalence of at least 10% were included. (See the appendix.) The effort-reward ratio was estimated as a continuous measure in order to improve the statistical power of the construct by logarithmic transformation that placed an inverse imbalance of the same magnitude in the same distance from 1 (when effort and reward were equal). Then the subjects were grouped into quintiles of the effort:reward ratio. The subjects were expected to suffer from a critical effort-reward imbalance when they belonged to the top quintile.

The 2nd summary measure concerned the personal component of the model, the critical pattern of coping termed overcommitment. This psychometric scale, containing 29 items, was composed of 4 subscales loading on one latent factor (23). The subjects scoring in the upper tertile of the sum score composed of the 4 scales were considered at risk from "overcommitment" (6, 22). These 2 summary measures, representing the situational and personal component of the model, were entered into the statistical analysis separately so that their relative strength of association with the health criteria under study could be tested. The respective alpha coefficients for the ERI scales were effort (0.85), reward (0.84), and overcommitment (0.65).

Additional contextual information on the work setting was selected in addition to the 2 types of described jobs, direct assembly-line work and indirect supportive tasks. This information included occupational status (middle managers versus manual workers) and shift work (rotation shift versus regular workhours).

Depressive symptomatology, as measured by the Center for Epidemiologic Studies Depression Scale (CES-D) (24), was chosen as the health criterion in this study. The test statistical properties of this widely used 20-item self-report measure have been described elsewhere (24). According to a tested Japanese version of the CES-D scale (25), depression was defined as a dichotomized variable with the cut point at a score of 16.

Sociodemographic data and information on health-related behavior (smoking and alcohol consumption) and on reports of major previous illness were collected as possible confounders.

Table 1. Correlation matrix for the job stress measures (N= 152—181).

	Demand	Control	Effort	Reward	Over-commitment
Demand		0.495 **	0.503 **	-0.329 **	0.290 **
Control			0.270 **	-0.261 **	0.121
Effort				-0.398 **	0.332 **
Reward					-0.371 **
Overcommitment					

*P<0.05, **P<0.01.

Statistical analysis

First, a correlation matrix was calculated to assess the independence (or interdependence) of the 5 measures of job stress entering the analysis (table 1). Next, a series of cross-tabulations of sociodemographic and work-related variables with the 5 stress measures was performed, using the chi-square test (table 2). To examine the effect of the job stress measures on depression, a logistic regression analysis was conducted in the following 3 steps: (i) by entering each job stress measure separately, (ii) by including all job stress measures simultaneously, adjusted for each other (table 3), and (iii), as a final exploratory step, by calculating separate logistic regression models for the two different job type groups to check whether the association with depression was stronger in the group facing potential job loss (table 4). Because of the small number in the final analysis, each job stress measure was entered into the model separately. The age (continuous variable), gender, and work-related variables with a statistically significant relationship with depression in the univariate analysis (χ^2 test) were selected as confounding factors in all the logistic models. The number of years of employment was highly correlated with age. Thus this variable was not included in the model. The analyses showed that neither the medical history nor the life-style variables altered the results. Accordingly these variables were not taken into account.

Results

The mean age of the study population was 36.5 (SD 9.0, range 20—59) years, and the mean duration of work

experience was 11.8 (SD 5.5, range 1—32) years. Of the subjects, 53% were men, 47% were women, 14% were middle managers, 86% were manual workers, 40% were indirect members (the group threatened by job loss), 60% were direct members, and 30% (N=56) were scheduled on shift work. There were no significant differences in age between the indirect and direct members (mean age=36.0 versus 38.2, t=1.58, P=0.116). However, men dominated among the indirect members (67%), whereas women were more frequent among the direct members (56%, χ^2=8.91, P=0.003). There were more employees holding a managerial position among

Table 2. Associations between the sociodemographic variables and job stress measures.[a]

Variables	High demand		Low demand		Low control		High control		Strain		Nonstrain		Effort reward imbalance		Effort reward balance		Over-commitment		Others	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Gender																				
Male	74	76	23	24	31	33	63	67	17	18	77	82	29	34	57	66	37	43	50	57
Female	40	51	39	49	55	68	26	32	22	28	56	72	8	11	66	89	13	18	59	82
Chi square	12.6				21.2				2.5				11.7				10.9			
P-value	0.000				0.000				0.115				0.000				0.001			
Occupational status																				
Managerial	25	100	0	0	0	0	24	100	0	0	24	100	12	57	9	43	11	50	11	50
Other employees	92	60	62	40	87	56	67	44	40	26	111	74	26	18	116	82	40	29	100	71
Chi square	15.7				26.5				8.2				15.4				4.0			
P-value	0.000				0.000				0.004				0.000				0.044			
Job type group																				
Direct members	60	57	45	43	69	66	36	34	30	29	73	71	16	16	82	84	26	28	68	72
Indirect members	55	76	17	24	17	24	54	76	9	13	61	87	22	35	41	65	25	37	42	63
Chi square	7.0				29.6				6.3				7.4				1.7			
P-value	0.008				0.000				0.012				0.007				0.194			
Shift work																				
Yes	38	68	18	32	27	49	28	51	16	29	39	71	14	27	37	73	16	31	35	69
No	77	64	44	36	58	48	64	52	23	19	96	81	24	21	88	79	35	32	75	68
Chi square	0.3				0.0				2.1				0.7				0.0			
P-value	0.584				0.849				0.151				0.399				0.955			

[a] The numbers do not add up to the total number of subjects due to missing values.

Table 3. Associations between each job stress measure and depression. (OR = odds ratio, 95% CI = 95% confidence interval)

	Adjustment for age, gender, occupational status, and job type (N=148—160)			Adjustment for age, gender, occupational status, job type and job characteristics[a] (N=135)		
Variables	OR	95% CI	P-value	OR	95% CI	P-value
High demand	1.14	0.52—2.47	0.746	0.83	0.32— 2.15	0.704
Low control	3.43	1.46—8.04	0.005	4.71	1.61—13.72	0.005
Strain	2.90	1.25—6.71	0.013	2.16	0.85— 5.51	0.106
Effort reward imbalance	3.75	1.56—9.05	0.003	4.13	1.39—12.28	0.011
Overcommitment	3.10	1.41—6.85	0.005	2.56	1.01— 6.47	0.047

[a] Four job characteristic measures (demand, control, effort-reward imbalance, overcommitment) were adjusted for each other. As for strain, the main components (demand and control) were not included in the model .

Table 4. Associations between each job stress measure and depression according to the job type group. (OR = odds ratio, 95% CI = 95% confidence interval)

	Indirect members (N=61—65)			Direct members (N=87—94)		
Variables	OR[a]	95% CI	P-value	OR[a]	95% CI	P-value
High demand	0.78	0.18— 3.35	0.736	1.45	0.56— 3.79	0.448
Low control	13.10	2.06— 83.18	0.006	2.09	0.74— 5.90	0.164
Strain	11.13	1.09—113.66	0.042	1.98	0.74— 5.27	0.171
Effort reward imbalance	8.70	2.08— 36.44	0.003	2.64	0.78— 9.00	0.120
Overcommitment	3.10	0.87— 11.07	0.082	3.70	1.29—10.60	0.015

[a] Adjusted for age, gender, and occupational status.

the indirect members (28%) than among the direct members (5%, χ^2=20.47, P=0.000), and there were fewer shift workers among the indirect members (19%) than among the direct members (37%, χ^2=6.64, P=0.010). The prevalence of depression observed in this sample was extremely high (39%, N=74). This finding contrasts to earlier findings obtained during the 1980s, when the prevalence of depression among economically active groups was reported to be no more than 15% (26).

As can be seen from the appendix, the response pattern for the items measuring psychological demand indicate a high prevalence of excessive workload and time pressure. Many jobs were characterized as monotonous and provided little opportunity for decision authority.

Four items measuring effort in the ERI model were relatively highly prevalent, namely, time pressure, high responsibility, pressure to work overtime, and increasing demands. Among the items measuring rewards, undesirable change at work, job insecurity, insufficient salary, and insufficient work prospects had the highest prevalences.

Table 1 presents a correlation matrix of the 5 job stress measures. As expected, a high correlation was found between demand and effort, 2 measures which operationalized similar aspects of stress for work settings. The focus of the former was on the subjectively reported frequency of occurrence, and the focus of the latter was on the subjectively reported intensity of distress in association with respective experience. The negative correlations between overcommitment, effort, and demand on one hand and reward on the other confirmed the theoretical assumptions underlying these measures, as did the positive associations between effort, demand, and overcommitment.

Cross-tabulations between the sociodemographic variables and the job-stress measures are presented in table 2. There were marked differences according to gender, occupational status, and job type, but not according to shift work. Adjustment for the demographic variables (the Mantel-Haenszel method) made the association between job type and job strain insignificant due to the small number. However, even after adjustment for the demographic variables, the association between job type and job control was highly significant (details not shown).

In table 3, the findings of 2 logistic regression models based on the total study population are presented. The one presented to the left has been adjusted for age, gender, occupational status, and job type, and the one represented to the right has also been adjusted for the remaining job stress measures. In the fully adjusted model (right side) an elevated risk of depression was observed among the employees who suffered from low control (OR 4.71, JDC model), from imbalance between effort and reward at work, and from overcommitment (OR 4.13 and 2.56 respectively, the two components of the ERI model).

Additional exploratory analyses (table 4) revealed potentially stronger effects in the group characterized by threat of job loss (the indirect members), in particular with regard to low control at work and effort-reward imbalance. Moreover, this group exhibited a significantly higher prevalence of depression than did the direct members, who were less exposed to job loss (details not shown).

Discussion

This paper documents an association between the components of 2 complementary models of job stress, the demand-control model and the effort-reward imbalance model, and depression for a sample of Japanese employees threatened by job loss. Low control at work, imbalance between effort and reward, and a high level of personal overcommitment were independently associated with depression in the total group, and these effects (with the exception of overcommitment) were potentially stronger in the subgroup facing an immediate threat of job loss at the time of the study. The study used psychometrically valid instruments; it included a broad majority of the workforce of the plant in question and consisted of both men and women, and it took a variety of work-related variables (eg, job type, occupational status, shift work) and potential confounders (age, gender, years of employment, medical history, health-related behavior) into account.

A second finding of interest concerns the additional evidence on the relative independence of the measures of the 2 theoretical models used, the JDC model and the ERI model (27—29). These measures, while being independently associated with depression, showed a different prevalence among the 2 subgroups of employees, effort-reward imbalance being more prevalent among the indirect members, threatened by job loss, and strain (low control) being more prevalent among the direct members, whose job tasks were determined by a machine-paced production line (30). The demonstration of statistically independent, yet explanatory useful measures of 2 job stress models points to the promise of combining 2 complementary approaches for the identification of adverse health conditions related to the psychosocial work environment.

Our findings agree with previous results on associations between job stress in terms of these 2 models and mental health (11, 28). However, to our knowledge, no such study has yet been conducted among economically active people in Japan, a country that only recently was confronted with substantial job insecurity, downsizing, and unemployment. We found a high prevalence of

excessive workload and limited control at work, and, despite cultural barriers against admitting emotional distress, a remarkable proportion of the employees reported dissatisfaction and concern about their salary and the future of their jobs. The men experienced job stress more often than the women, but the association between job stress and depression did not differ between the genders. Similarly, the distribution of job stress according to occupational status and job type differed, but, with the exception of immediate threat of job loss (indirect members), as demonstrated in table 4, the respective associations with depression did not differ.

Despite these merits, our study suffered from several limitations. First, its cross-sectional design prevented the study of causal influences on the observed associations. We could not rule out the possibility that depressed people exhibit a higher probability of reporting negative experience in general, including work conditions. Such a tendency toward negative affectivity has been shown to inflate the statistical associations of stressor-strain relationships (31) although its impact should not be overstated (11, 32).

A second limitation concerns the relatively small size of the sample and the selectively missing data. The small sample size limited the options of including additional variables in a multivariate analysis and also the options for stratified subgroup analysis. On the other hand, the multivariate prevalence odds ratios for depression among the employees exposed to low job control and suffering from effort-reward imbalance at work were impressive, and their confidence intervals were acceptable (see table 3). As the sample consisted of almost 90% of the total workforce of this plant, the finding may shed some light on precarious work conditions in small companies whose economic survival is largely dependent upon the strategies of large national or international enterprises.

A lack of psychiatric validation of the obtained measures of depression and the lack of any physiological indicators of depressive risk (eg, diurnal profile of cortisol secretion) further limited the significance of this report. On the other hand, we may have run the risk of underestimating an association between job stress and the employees' health, as this study included only 1 health indicator (ie, depression). Several prospective and cross-sectional studies have documented an elevated risk of cardiovascular, gastrointestinal, and musculoskeletal disorders among people exposed to high demand and low control or an effort-reward imbalance at work (2, 5, 29). Moreover, we restricted the range of adverse psychosocial conditions to worklife and neglected the well-documented influences of negative life events and chronic interpersonal difficulties on depression (33).

A final comment concerns the policy implications of these findings. Although further independent support from investigations based on more convincing study designs is needed, the current state of the art may already justify the application of preventive measures on the basis of the results obtained with the 2 models. In fact, intervention studies have been conducted both with the JDC model (5) and with the ERI model (34). Such measures included structural changes (job redesign, work reorganization) and interpersonal and individual intervention (training in social skills, coping with job stress, and the like).

In conclusion, despite the limitations mentioned, this study provides evidence of significant associations between theoretically grounded measures of job stress and depression in a sample of Japanese employees facing job loss in their plant. The findings call for intensified preventive efforts by those who hold the responsibility for occupational health. In particular, such measures should be targeted towards vulnerable groups such as the ones threatened by job loss.

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Appendix

Prevalence of the worst two categories the participants rated on each item of the two job-stress questionnaires

Job demand-control

Prevalence of frequent occurrence

Item	*Prevalence (%)*
Demand	
Fast work	75.7
Hard work	43.2
Excessive work	57.9
Insufficient time to do work	78.9
Conflicting demands	37.3
Control	
Learning new things	26.3
Skill requirement	27.4
Creativity required	35.3
Repetitiousness	73.7
Little decision freedom	63.1
No allowance for own decisions	57.4

Effort-reward imbalance

Prevalence of intense stress experience

Item	*Prevalence (%)*
Effort	
Time pressure	15.0
Interruptions	10.1
Responsibility	12.8
Pressure to work overtime	16.0
Physically demanding work	10.0
Increasing demands	11.0
Reward	
Insufficient respect by superiors	5.0
Insufficient respect by colleagues	1.7
Inadequate support	2.3
Unfair treatment	4.1
Undesirable change	11.7
Poor promotion prospects	4.4
Job insecurity	11.5
Insufficient position	5.1
Insufficient respect or prestige	4.2
Insufficient work prospects	9.9
Insufficient salary	14.5