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Three job stress models and their relationship with musculoskeletal pain in blue- and white-collar workers☆

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ABSTRACT

Objectives: Musculoskeletal pain has been found to co-occur with psychosocial job stress. However, different conceptualizations of job stress exist, each emphasizing different aspects of the work environment, and it is unknown which of these aspects show the strongest associations with musculoskeletal pain. Further, these associations may differ for white-collar vs. blue-collar job types, but this has not been tested. The present study examined the independent and combined contributions of Effort–RewardImbalance (ERI), Job-Demand–Control (JDC) and Organizational Justice (OJ) to musculoskeletal pain symptoms among white- and blue-collar workers.

Methods: Participants of a cross-sectional study (n = 1634) completed validated questionnaires measuring ERI, JDC, and OJ, and reported the frequency of pain during the previous year at four anatomical locations (lower back, neck or shoulder, arms and hands, and knees/feet). Pain reports were summarized into a single musculoskeletal symptom score (MSS). Analyses were stratified for white- and blue-collar workers.

Results: Among white-collar workers, ERI and OJ were independently associated with MSS. In addition to these additive effects, significant 2-way and 3-way interactions indicated a synergistic effect of job stressors in relation to reported pain. In blue-collar workers, ERI and JDC independently associated with MSS, and a significant 3-way interaction was observed showing that the combination of job stressors exceeded an additive effect.

Conclusion: ERI influences pain symptoms in both occupational groups. OJ was independent significant predictor only among white-collar workers, whereas JDC had additive predictive utility exclusively among blue-collar workers. Simultaneous exposure to multiple job stress factors appeared to synergize pain symptom reporting.

Introduction

Musculoskeletal pain is highly prevalent in the workforce [1,2]. For instance, in a survey among 15,000 employees from 15 European countries, back pain and muscular pain were among the most frequently reported work-related health problems (reported by 30% and 19%, respectively) [3]. Chronic pain accounts for a large proportion of total sickness absenteeism, presenteeism (reduced productivity due to sickness at work), and health care utilization, thereby impairing quality of life and incurring considerable costs on health care systems and employers alike [4]. Moreover, chronic pain has been found to predict other adverse health outcomes, such as the metabolic syndrome, cardiovascular disease, depression and anxiety disorders [5,6].

While it is well known that a high physical workload is a risk factor for musculoskeletal pain, adverse psychosocial work conditions are also predictive. For example, a meta-analysis of longitudinal studies reports positive and significant pooled odds ratios ranging from 1.2 to 1.7 for psychosocial job stressors [4]. Despite convincing evidence that job stress is a determinant of pain reporting, there still is limited understanding of which characteristics of a stressful work environment may have the largest impact [7,8]. Such characteristics have been captured by three theoretical models of job stress, which each emphasize different work place features; i.e., the Job-Demand–Control (JDC) model [9], the Effort–Reward-Imbalance model (ERI) [10], and Organizational Justice (OJ) [11,12]. The JDC model proposes that job strain stems from situations involving exposure to high job demands (e.g., work load) and low job control (e.g., pacing, variety, decision latitude). The ERI model conceptualizes job stress as a result of situations in which efforts are insufficiently reciprocated (e.g., in the form of salary, praise,

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promotion prospects). Finally, the OJ model emphasizes the role of fairness perceptions, e.g., regarding the distribution of resources, the fairness of decision-making processes, and the fairness in interpersonal interactions. The majority of studies on pain have utilized the JDC model and to a lesser extent also the ERI model (e.g., [7,8]), while only a single study considered OJ as a determinant of pain [13].

Research suggests that a multi-model approach may improve predictions of health outcomes [14,15]. Job stress conceptualizations may have independent additive effects, i.e., indicating that job stress conceptualizations are complementary, or they may interact as they reinforce or weaken each other. For example, there is evidence that the combined effects of JDC with ERI better predict poor health outcomes than each model separately, which has been documented for self-rated health, insomnia, distress, and acute myocardial infarction [16–20]. Likewise, a prospective study among public sector employees showed that the combination of high ERI and high OJ was linked to poorer health (i.e., in terms of self-rated health, psychiatric morbidity, and physician-diagnosed depression) as opposed to individual job stress models [21]. Regarding musculoskeletal pain symptoms, a recent study among intensive care unit nurses showed a significant association for the combination of ERI and JDC, however adding JDC provided little gain to using ERI only [22]. Analyses of both the independent and combined associations of the three job stress models may help to understand which constellation of job stressors and psychosocial work conditions explain individual differences in reported pain and may facilitate the design of occupational interventions.

It is recognized that the impact of job stressors on health may vary across occupational groups. For example, job strain, as characterized by the JDC model, seems to carry a higher risk for cardiovascular disease among blue-collar workers than among white-collar workers [23–26]. Blue-collar workers can be distinguished from white-collar workers primarily on the basis of work content and context: production work vs. non-manual office work. Blue-collar jobs tend to be characterized by lower levels of autonomy, lower intellectual discretion and poorer task variety as compared to white-collar jobs [27]. The JDC model was initially developed with data from blue-collar professions, and consequently may capture work stressors that are more pertinent to this occupational subpopulation [26]. By contrast, there is emerging evidence that OJ is relatively more impactful among white-collar employees [28,29], which has been attributed to their specific relationship with their employer, involving obligations and expectations beyond the formal contract, implying high levels of commitment and trust [28]. ERI has been found to be equally associated with poor health among both blue- and white-collar workers and has comparable psychometric properties in both populations [30]. Consequently, separate analyses of associations of each of the job stress models for white- versus blue-collar workers seems warranted.

A distinction between white- and blue-collar workers appears beneficial for another reason. Blue-collar jobs are more physical demanding and work conditions are typically adverse, strenuous, and precarious conditions (e.g., monotonous, highly repetitive, lifting and carrying heavy loads, poor posture, and shift work) [31,32]. A recent study however reports higher, but not significantly different, prevalences of most pain symptoms (i.e., neck, shoulder, elbow, upper and lower back) for white-collar than for blue-collar workers [33].

In light of the previous discussion, the present study aimed to determine the associations of self-reported musculoskeletal symptoms with the three most commonly employed job stress models (i.e., ERI, JDC, OJ), which are considered separately for white- and blue-collar workers. It was hypothesized that for white-collar workers ERI and OJ are the strongest determinants for musculoskeletal symptoms, while for blue-collar workers in particular ERI and JDC would be associated with musculoskeletal symptoms. In addition, analyses explored if additive effects emerge and whether considering the interaction of stress conceptualizations would yield further gain in terms of explained variance in reported musculoskeletal symptoms.

Materials and methods

Study population

Cross-sectional data from the 2007 Mannheim Industrial Cohort Studies (MICS) were used. The study population comprised employees of a large aircraft manufacturer in the South of Germany. All employees (N = 2567) were invited to participate in a free health check. A total of 1634 employees (64%) volunteered and completed a questionnaire, covering demographics, health outcomes and health behaviors, and measures of job stress, as detailed below. All participants provided a written consent and the ethics committee of the Medical Faculty Mannheim, Heidelberg University, approved the study procedures.

Measures

Job stress measures

Effort–Reward Imbalance (*ERI*) [10,30] was measured by a 17-item scale, assessing effort by six items and reward by 11 items. As recommended, for white-collar workers the five-item effort version was used while excluding physical load [30]. Generally, participants specified if

Table 1
Sample characteristics.

	White-collar (n = 685)		Blue-collar (n = 747)			
	Mean/%	SD/n	Mean/%	SD/n	Test value	*p* value
Musculoskeletal symptoms score (mean, SD)	7.19	1.91	7.52	2.01	11.01[c]	0.001
Age (years (mean, SD))	41.96	10.79	36.29	12.24	94.48[c]	<0.001
Male	82.7%	560	92.1%	773	31.29	<0.001
Professional education					272.12	<0.001
Apprentice or lower	56.1%	344	93.3%	697		
Vocational/master school	18.6%	114	5.4%	40		
Academic degree	25.3%	155	1.3%	10		
Shift work					237.76	<0.001
No shift work	84.0%	568	45.7%	398		
Shift work	16.0%	108	54.3%	472		
Employment status					26.10	<0.001
Permanent	86.1%	556	75.4%	627		
Non-permanent	13.9%	90	24.6%	205		
Smoking status					15.69	<0.001
Never smoker	42.5%	291	37.6%	329		
Ex smoker	28.3%	194	23.7%	207		
Smoker	29.2%	200	38.7%	339		
Physical exercise (h/week)					1.64	0.651
Regularly more than 2 h	28.7%	195	27.0%	236		
Regularly 1 to 2 h	28.5%	194	27.5%	240		
Less than 1 h	17.2%	117	17.2%	150		
No exercise	25.6%	174	28.4%	248		
Alcohol consumption (g/day) (mean, SD)	17.91	24.6	17.27	25.69	0.25	0.621
Body Mass Index (mean, SD)	24.10	3.54	24.54	4.75	3.99[c]	0.046
Physical workload factor 1[a] (mean, SD)	1.20	0.85	0.31	0.59	546.49[c]	<0.001
Physical workload factor 2[b] (mean, SD)	0.48	1.11	1.52	1.49	251.02[c]	<0.001
Effort-reward imbalance ratio (mean, SD)	0.62	0.29	0.62	0.29	0.98[c]	0.324
Job strain (mean, SD)	0.91	0.28	1.02	0.35	41.93[c]	<0.001
Organizational injustice (mean, SD)	2.63	0.70	2.81	0.74	24.67	<0.001

Test value χ^2 for categorical variables and *F* value for continuous scores.
a “Mostly sitting” and “working mostly in front of the monitor”.
b “Lifting heavy loads”, “frequent stooping”, “working overhead or twisted posture (e.g. during installation)”, “lifting the loads in forward leaning posture”, “working on knees”.
c Asymptotically F distributed (Brown–Forsythe).