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Perceived Work Stress, Overcommitment, and Self-Reported Musculoskeletal Pain: ACross-Sectional Investigation

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The objective of this study was to analyze associations of three indicators of perceived work stress (physical job demand, low control at work, and an imbalance between effort and reward), and of overcommitment, a personal pattern of coping with work demands, with musculoskeletal pain. A standardized questionnaire measuring these conditions in addition to self-reported musculoskeletal pain at different locations was administered to a group of 316 male and female employees of a public transport enterprise. After we adjusted for confounding effects of age, sex, socioeconomic status, shift work, and negative affectivity, we observed elevated prevalence odds ratios in employees who scored high on overcommitment, who were exposed to physical job demand, and, to a lesser extent, who reported psychosocial work stress. Results have implications for a more comprehensive approach to primary and secondary prevention of musculoskeletal pain.

Key words: musculoskeletal pain, physical job demand, control at work, effort–reward imbalance, overcommitment

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Musculoskeletal pain is a common medical complaint and a frequent cause of sickness absence in industrialized countries (Brogmus, Sorock, & Webster, 1996). According to recent studies, the most common musculoskeletal symptoms are neck and back pain. In general populations, the 1-year prevalence was found to vary between 30% and 40% (Bovim, Schrader, & Sand, 1994) and between 32% and 62% (Berger-Schmitt, Kohlmann, & Raspe, 1996) for neck and back pain, respectively. Prevalence data in working populations are even higher (Cole & Hudak, 1996; Eriksen, Natvig, Knardahl, & Bruusgaard, 1999; Magnavita, Bevilacqua, Mirk, Fileni, & Castelino, 1999; Magnusson, Pope, Wilder, & Areskoug, 1996; Riihimäki, 1999). Additional sites of frequent musculoskeletal complaints are the shoulder, hip, and upper and lower extremities. In all these instances, interventions based on principles of behavioral medicine are instrumental in reducing pain and in improving coping with ill health (Eriksen & Ursin, 1999). Yet, more information is needed on specific environmental and personal factors that contribute to the development of musculoskeletal pain and, thus, may define targets of intervention. Among environmental factors, working condition, in particular physical workload, plays a prominent role (Ariëns, van Mechelen, Bongers, Bouter, & van der Wal, 2000; Bernard, 1997; Hagberg et al., 1995; Magnavita et al., 1999; Walsh, Varnes, Osmond, Styles, & Coggon, 1989). More recently, a stressful psychosocial work environment was shown to be associated with elevated risk of musculoskeletal pain (Bongers, de Winter, Kompier, & Hildebrandt, 1993; Foppa & Noack, 1996). Among these conditions, a low degree of task control at work seems to be particularly relevant (Bongers et al., 1993; Hollmann, Heuer, & Schmidt, 2001; Houtman, Bongers, Smulders, & Kompier, 1994). In addition to situational factors, personal ways of coping with demands have to be taken into account (Bongers et al., 1993; Eriksen & Ursin, 1999).

This study was undertaken to explore associations between a new measure of psychosocial stress at work, effort–reward imbalance, and musculoskeletal pain in a working population with high prevalence of these conditions (Siegrist, 1996). We chose this new measure of work stress because it allows to the researcher to distinguish between perceived situational work stressors and personal coping characteristics at the conceptual and operational level. This model maintains that the availability of an occupational status is associated with recurrent options of contributing and performing, of being rewarded or esteemed, and of belonging to some significant group (e.g., colleagues). Yet, these potentially beneficial effects are contingent on a basic prerequisite of exchange in social life, that is, reciprocity. Effort spent at work is part of a socially organized exchange process to which society at large contributes in terms of rewards. Rewards are distributed by three transmitter systems: money, esteem, and career opportunities. The model of effort–reward imbalance claims that lack of reciprocity between the costs and gains (i.e., high-cost/low-gain conditions) defines

a state of emotional distress with special propensity to autonomic arousal and neuroendocrine stress responses. For instance, having a demanding but unstable job or achieving at high level without being offered any promotion prospects are examples of a particularly stressful working context. High-cost/low-gain conditions are maintained under the following three circumstances. First, when an alternative choice in the labor market is not available, anticipated costs of disengagement outweigh the costs of accepting inadequate benefits. Therefore, unrewarding jobs are held. Second, people may accept unfair job arrangements for a certain time for strategic reasons, because they may improve their chances for career promotion and related rewards at a later stage.

A third reason for a continued mismatch between efforts and rewards points to a particular pattern of coping with work-related demands and rewards. People characterized by an excessive job involvement, as previously described in the Type A behavior pattern, may expose themselves to recurrent sustained activation. In a refined concept of excessive job involvement, termed *overcommitment* (Siegrist, 1996), a cognitive–motivational pattern has been identified where a high level of overcommitment prevents people from accurately assessing the costs and gains of demanding challenges. Because the experience of mastering demands is rewarding for them, they are likely to overestimate their coping resources and underestimate the efforts required for mastering demands. In the long run, overcommitted people suffer from their inability to withdraw from work obligations. Despite a positive outcome expectancy, cumulative load of their excessive efforts reduces their potential of recovery and increases their susceptibility to ill health (Siegrist, 2001; Ursin & Eriksen, 2001).

Therefore, we analyze the role of these two components of the model of effort–reward imbalance, perceived situational work stressors as measured by a ratio between demands and rewards (see Methods section), and the personal coping pattern of overcommitment, in explaining musculoskeletal symptoms at different sites. Additional explanatory factors are physical workload and low control at work (Karasek & Theorell, 1990). To adjust for possible confounding effects, age, sex, socioeconomic status, and shift work are taken into account in multivariate analyses. In addition, a measure of negative affectivity is included to reduce bias due to the substantial methodological problem of common method variance (Abraham, 1999).

METHODS

Participants

A group of female and male employees of a large public transport company in a major city in Germany were invited to participate in this cross-sectional study.

Participants provided written informed consent. Data were collected during two working days in a separate facility under standardized and controlled conditions. Selection criteria for participation were (a) age (35 years), (b) duration of employment in the company at least 2 years, and (c) fluency in German language. Restriction to midlife (35–60 years) was decided because effects of work stress are expected to be more prevalent in this group compared with a younger group (Morano, 1993).

Although a majority of employees were bus and subway drivers, we did not restrict participation to this employment group but invited repair personnel and administrative personnel to participate as well. The study was undertaken with support from the company's occupational health department. A notice about voluntary participation was put up in two of four bus drivers' working sites and in the administration building of the company. This means that about 1,000 employees fulfilling sample criteria had a chance of being informed about the study. However, because data collection was restricted to 2 days and the survey was conducted before or after regular working time, the size of the eligible population was far smaller. A total of 316 employees participated (268 men and 48 women). Although we cannot exclude a selection bias due to a high level of perceived work stress or health complaints, the participants' feedback indicated that their interest in a scientific survey and the financial incentive offered were equally strong motivations for participation.

We did not intend to recruit a representative sample, but it turned out that the proportions of the different occupational groups of the sample were well comparable to the company's composition of workforce. The fact that few women participated reflects the low proportion of women employed in this enterprise, although women in our sample were clearly underrepresented. Mean age of participants was 44.8 years (7.6) among men and 43.7 (6.4) among women. Half of the participants were bus or subway drivers, 23% were white-collar workers, and 19% were blue-collar workers in repair services. Almost all participants were full-time employed. Mean employment time in the current job was 16.1 (8.6) years, and shift work was frequent among participants (78%; the majority, 46%, involving night shift). In addition, 63.1% had a low level of education (elementary school), and 21.8% had a household income lower than 3000 DM per month after taxes.

Measures

Perceived Work Stress. Low control at work was measured by three items representing the Job Decision Latitude scale derived from the Job Content Questionnaire, a widely used measure of psychosocial work stress in terms of high demand and low control (Karasek et al., 1998). Physical job demand and effort–re-

ward imbalance were assessed by a Likert-scaled standardized questionnaire. Items are answered in two steps. First, participants agree or disagree on whether the item content describes a typical experience of their work situation. Subsequently, participants who agree are asked to evaluate to what extent they usually feel distressed by this typical experience (4-point Likert scale). Physical job demand is measured by one item, whereas five items define a scale of effort (quantitative and qualitative load, increase of work demands in recent past). Eleven items define a scale of occupational rewards (financial rewards, esteem rewards, and rewards related to promotion prospects and job security). Psychometric properties of the questionnaire including factorial structure and internal consistency of scales were reported by Niedhammer, Siegrist, Landre, Goldberg, and Leclerc (2000), Peter et al. (1998), and Siegrist (1996). In this study, internal consistency (Cronbach's $\alpha =$ 0.72 and 0.86, respectively) and factorial structure of the Effort and Reward scales were consistent with previous analyses. The ratio of the sum score extrinsic effort (e) and the reversed sum score of reward (r) was computed according to the following formula: $e / (r \times c)$, where c defines a correction factor for different numbers of items in the nominator and denominator. As a result, a value of 1.0 indicates effort–reward balance, whereas values >1.0 indicate the critical condition of high effort and low reward. Based on this threshold, a binary variable of the extrinsic model component was defined: effort–reward ratio, high or low.

Overcommitment. The personal pattern of coping with work demands termed overcommitment was measured by a recently developed short version (six items, see the appendix) of the original 29-item version of a psychometric test (Starke et al., 2002). In previous studies, overcommitment was associated with elevated risks of coronary heart disease, indicators of the metabolic syndrome, coronary reocclusion after percutaneous transluminal coronary angioplasty, and burnout (for review, see Schnall, Belkic, Landsbergis, & Baker, 2000; Siegrist, 2001). This study offers an opportunity to explore associations of overcommitment with a different health indicator, musculoskeletal pain. The short version of the overcommitment scale was developed because previous confirmatory factor analyses that used the original 29-item version showed that its explanatory power was confined largely to the Inability to Withdraw From Work Obligations subscale, a subscale that was particularly well replicated across different data sets (Niedhammer et al., 2000). Therefore, confirmatory factor analysis based on data from two large international samples and from two smaller German samples was performed where the unidimensionality of the scale, its internal consistency, and the variance explained *[Goodness-of Fit-Index (GFI), Adjusted-Goodness-of-Fit Index (AGFI), Root-Mean-Square Error of Approximation (RMSEA).] were analyzed by using maximum likelihood method (Starke et al., 2002). In the current

sample, respective values were $\alpha = 0.73$, GFI = 0.98, AGFI = 0.95, and RMSEA = 0.06, and loadings (α^2) ranged from 0.31 to 0.84. In line with previous analyses, a binary variable was computed with scores in the upper tertile defining a critical level of overcommitment (value = 1) versus the remaining group with scores indicating low or moderate overcommitment (value = 0).

Negative Affectivity. Several authors now recommend adjusting the effects of psychosocial measures on health indicators in cross-sectional studies for mood-dispositional variables such as negative affectivity (Abraham, 1999; Burke, Brief, & George, 1993). Negative affectivity describes a tendency to react with negative mood to all types of self-reported items. Thus, this tendency may inflate the previously mentioned associations. In this study, negative affectivity was assessed by the Negative Affect scale (eight items) of the Profile of Quality of Life in Chronically Ill People (Siegrist, Starke, Laubach, & Brähler, 2000). Construct validity was documented by a unidimensional factor structure with all items loading on a single factor. The scale was shown to be highly reliable in several studies (Cronbach's α ranging from 0.82 to 0.93), and its psychometric quality was replicated in a representative sample of healthy men and women in Germany (Siegrist et al., 2000). Again, we constructed a binary measure with scores in the upper tertile defining a high level of negative affectivity.

Musculoskeletal Symptoms. A standardized, widely tested questionnaire measuring the frequency of musculoskeletal pain at different sites of the body was administered (Berger-Schmitt et al., 1996). This questionnaire was applied in several representative health surveys in Germany, thus providing reference information (Berger-Schmitt et al., 1996). Participants were asked to assess in which part of the body (neck, shoulder, elbow, hand, back, hip, knee, foot) they had experienced recurrent pain during the previous 12 months and again during the previous 7 days. In this study, we relied on data on the previous 12 months because this information may describe chronic musculoskeletal pain more accurately. We dichotomized respective variables with the category "yes" defining presence and "no" defining absence of musculoskeletal symptoms.

Data Analysis

All analyses were conducted on a personal computer with SPSS Version 9.0 (SPSS Institute, Chicago, IL). First, univariate and bivariate analyses were performed. Student's *t* test in case of normal distribution or Mann–Whitney *U* test was applied

for continuous data, and a chi-square test was applied in case of categorical variables to characterize the two groups of interest (musculoskeletal pain present vs. absent). To test the hypothesis of associations of three indicators of perceived work stress (physical load, low control, high ratio of effort–reward imbalance) and of overcommitment with musculoskeletal symptoms, we performed multivariate logistic regression analyses. In the first model, the four predicting variables were included, they were adjusted for each other, and respective odds ratios of musculoskeletal symptoms at different sites were calculated. In this model, odds ratios were adjusted for age and sex. In the second model, education and household income, as indicators of socioeconomic status, and shift work were introduced as confounders. The final model included negative affectivity as a measure of reporting bias. With one exception to be discussed, no significant changes in the odds ratios were observed during this final step. Results therefore are given for Models 1 and 2. Multivariate odds ratios and 95% confidence intervals are displayed. In view of the relatively small sample size, a level of significance $p < .05$ was considered appropriate.

RESULTS

Table 1 describes the sample in terms of perceived work stress variables. In this sample of employees of an urban transport enterprise, 33.4% reported physical job demand, 27.4% from low control at work and 15.1% from an imbalance between effort and reward. Thirty-six percent scored high on overcommitment and 30.6% scored high on negative affectivity. Moderate correlations were found between negative affectivity and overcommitment ($r = .33$) and between negative affectivity and effort–reward ratio ($r = .35$), thus indicating no substantial overlap.

The 1-year prevalence of musculoskeletal symptoms was relatively high: 70.4% for back pain, 60.1% for neck pain, and 52.9% for shoulder pain. Symptoms related to hip (24.3%) and to upper (36.2%) and lower extremities (46.2%) were reported less frequently. It should be kept in mind that these figures include all participants who experienced recurrent pain at least once during the past 12 months. If restricted

TABLE 1
Perceived Work Stress Variables in 316 Employees of a Traffic Company

Variable	*Items*	*Rating*	*Range*	*M*	*SD*
Effort	5	1–5	5–25	12.48	3.93
Reward	11	1–5	11–54	24.25	8.94
Overcommitment	6	1–4	6–24	12.27	3.75
Physical work demand	1	1–5	1–5	1.67	1.07
Control	3	1–5	3–14	4.72	2.38

TABLE 2
One-Year Prevalence of Self Reported Musculoskeletal Pain by SocioDemographic Variables, Socioeconomic Variables and Negative Affectivity

	Neck Pain			*Shoulder Pain*			*Back Pain*			*Hip Pain*			*Upper Extremities*			*Lower Extremities*		
	PR	*n*	*p*[a]	*PR*	*n*	*p*	*PR*	*n*	*p*	*PR*	*n*	*p*	*PR*	*n*	*p*	*PR*	*n*	*p*
Sex																		
Female	76.2	32		59.5	25		64.3	27		23.1	9		51.2	22		47.6	20	
Male	57.2	143	.020	51.6	128	ns[b]	71.4	177	ns	24.2	60	ns	33.7	83	.028	46.2	115	ns
Age																		
<40	61.6	53		47.7	42		27.1	55		16.9	15		30.0	27		36.0	32	
40–49	63.6	82		53.5	68		48.3	98		24.2	30		34.7	43	47.2	59		
>50	51.9	40	ns	56.8	42	ns	24.6	50	ns	31.5	23	ns	45.9	34	ns	56.6	43	.029
Education																		
Low	64.3	153		55.9	133		70.3	166		23.9	56		38.7	92		46.9	112	
High	42.3	22	.003	40.0	20	.041	71.2	37	ns	27.5	14	ns	26.5	13	ns	44.0	22	ns
Household income																		
< 3000 DM	59.7	37		54.1	33		56.7	34		26.2	16		35.0	21		41.9	26	
>3000 DM	61.1	138	ns	53.1	120	ns	74.3	168	.008	24.3	54	ns	36.0	81	ns	48.0	108	ns
Shift work																		
Shift work	65.1	140		57.5	123		72.2	153		25.4	53		39.8	84		45.3	96	
No shift work	46.2	36	.003	40.3	31	.009	65.0	52	ns	21.5	17	ns	26.6	21	.037	48.8	39	ns
Negative affectivity																		
High	73.6	67		58.2	53		82.4	75		34.1	30		45.1	41		51.6	47	
Low	53.6	104	.001	50.3	96	ns	65.6	126	.004	18.8	36	.005	32.1	61	.035	44.0	85	ns

Note. PR = prevalence rate.

[a]Significance of χ^2. [b]Not significant, ($p > .05$).

to pain experienced during the past 7 days, prevalence rates are substantially lower. Table 2 shows results of bivariate analyses between the six confounding variables and different sites of musculoskeletal symptoms. Due to the relatively homogenous sample in terms of age, no substantial age-related effects were observed. Concerning sex, women more often reported neck pain and pain in upper extremities compared with men. The two indicators of socioeconomic status were not consistently related to musculoskeletal symptoms, although there was a tendency toward more symptoms in the less educated group. Shift workers (i.e., bus and subway drivers and repair personnel) reported higher levels of pain, in particular neck, shoulder, and upper extremity pain. As expected, a high level of negative affectivity was consistently associated with prevalence of reporting musculoskeletal pain.

Table 3 indicates findings for the four predicting variables on which the test of the hypothesis was based. As can be seen, each indicator of perceived work stress shows some association with musculoskeletal pain, but differences in general are not substantial. Yet, the personal coping pattern of overcommitment clearly is related to symptom reporting, because differences are marked in four of six conditions of musculoskeletal pain.

To test the hypothesis, results of logistic regression analyses based on the two models are given in Table 4. Odds ratios and confidence intervals refer to exposure status, that is, high physical job demand, low control, high ratio of effort–reward imbalance, and high level of overcommitment. Reference categories with an odds ratio of 1.0 were low physical job demand, high control, low ratio of effort–reward imbalance, and low level of overcommitment. In Model 1, odds ratios of the four predicting variables were adjusted for each other and, in addition, for age and sex. Model 2 introduced education, household income, and shift work as additional confounders. As can be seen, overcommitment was more strongly and more consistently associated with musculoskeletal pain, compared with the three indicators of perceived work stress. Further adjustment for negative affectivity, although not affecting all remaining results, slightly reduced the odds ratio of overcommitment for lower extremities from 1.93 to 1.88 (confidence interval = .98 – 3.62; p = .057).

DISCUSSION

This study provides preliminary evidence of an association of indicators of perceived work stress and of a personal pattern of coping with work demands, overcommitment, with musculoskeletal symptoms at different bodily sites in a sample of middle-age public transport employees. Associations were relatively strongest for overcommitment, where the risk of experiencing recurrent neck and hip pain clearly was elevated. Physical job demand and, to a lesser extent, low control and effort–reward imbalance also were related to the experience of

TABLE 3
One Year Prevalence of Self Reported Musculoskeletal Pain
by Perceived Work Stress and Overcommitment

	Neck Pain			*Shoulder Pain*			*Back Pain*			*Hip Pain*			*Upper Extremities*			*Lower Extremities*		
	PR	*n*	*p*[a]	*PR*	*n*	*p*	*PR*	*n*	*p*	*PR*	*n*	*p*	*PR*	*n*	*p*	*PR*	*n*	*p*
Physical job demand																		
Yes	60.0	57		73.4	69		27.4	26		27.4	26		44.8	43		35.6	48	
No	60.1	119	ns[b]	48.5	95	.029	69.0	136	ns	22.8	44	ns	32.0	62	.032	44.6	87	ns
Control																		
Low	70.9	56		61.3	49		76.8	63		27.5	22		43.8	35		55.6	45	
High	56.3	117	.024	49.3	101	ns	68.0	138	ns	23.6	48	ns	34.1	70	ns	42.9	88	ns
Effort-reward ratio																		
High	76.7	33		62.8	27		77.8	35		43.2	19		39.1	18		59.1	26	
Low	59.3	131	.031	51.4	114	ns	71.2	158	ns	22.0	48	.003	36.7	80	ns	45.0	99	ns
Overcommitment																		
High	77.5	62	61.3	49	81.5		81.5	66		38.0	30		40.7	33		59.3	48	
Low	51.3	96	.000	48.6	90	ns	65.8	121	.010	20.2	37	.02	35.0	64	ns	42.2	78	.010

Note. PR = prevalence rates.

[a]Significance of χ^2. [b]Not significant, ($p > .05$).

TABLE 4
Odds Ratios (OR), Confidence Intervals (CI), and p-Values of Musculoskeletal Pain by Perceived Work Stress and Overcommitment, Adjusted for Age and Sex (Model 1), and Additionally Adjusted for Socio-Economic Status and Shift Work (Model 2)

	Neck Pain			*Shoulder Pain*			*Back Pain*			*Hip Pain*			*Upper Extremities*			*Lower Extremities*		
	OR	*CI*	*p*	*OR*	*CI*	*p*	*OR*	*CI*	*p*	*OR*	*CI*	*p*	*OR*	*CI*	*p*	*OR*	*CI*	*p*
PJD																		
M1	1.30	.71–2.35	.384	2.11	1.19–3.75	.010*	1.44	.76–2.73	.260	1.40	.74–2.66	.298	2.27	1.26–4.09	.006*	1.54	.87–2.72	.132
M2	1.14	.61–2.13	.675	1.94	1.07–3.52	.028*	1.68	.85–3.33	.136	1.32	.67–2.57	.411	2.15	1.25–4.31	.007*	1.71	.94–3.10	.076
CON																		
M1	1.24	.61–2.51	.542	2.12	1.08–4.14	.027*	1.66	.77–3.55	.190	0.84	.39–1.79	.654	2.30	1.15–4.58	.017*	1.72	.89–3.35	.106
M2	1.06	.51–2.22	.862	1.82	.91–3.62	.088	1.56	.71–3.43	.267	0.77	.35–1.70	.524	2.32	1.05–4.40	.035*	1.90	.956–3.78	.067
ERR																		
M1	1.85	.77–4.47	.168	1.47	.67–3.25	.334	1.37	.55–3.43	.495	3.08	1.37–6.90	.006*	0.77	.34–1.70	.522	1.61	.74–3.47	.226
M2	2.00	.78–5.16	.149	1.48	.65–3.34	.345	1.44	.54–3.83	.456	3.11	1.36–7.09	.007*	0.74	.32–1.67	.472	1.67	.75–3.72	.204
OC																		
M1	3.11	1.56–6.21	.001*	1.15	.62–2.11	.645	1.60	.79–3.22	.190	2.29	1.19–4.38	.012*	1.10	.59–2.04	.758	1.971	.07–3.60	.027*
M2	4.33	2.02–9.26	.000*	1.35	.71–2.56	.346	1.75	.84–3.64	.131	2.31	1.18–4.52	.014*	1.18	.61–2.27	.609	1.93	1.03–3.61	.038*

Note. PJD = physical job demand; CON = control; ERR = effort-reward ratio; OC = over- commitment; M1 = Model 1: Workload, Low control, Effort–reward ratio, Overcommitment, Age, Sex. Model 2: M2 = Model 1 + socioeconomic status (education, income) + shift–work.

*$p < .05$.

musculoskeletal pain. Results were adjusted for the effects of age, sex, socioeconomic status, and occupational group (shift work). Moreover, a measure of negative affectivity was introduced given the challenge of common method variance in a cross-sectional study design. Data were obtained from standardized, psychometrically validated questionnaires and were collected under standardized conditions. Information obtained through these measures allowed us to distinguish between (a) physical and psychosocial work stressors, (b) perceived situational stressors related to the work environment and a personal coping characteristic, and (c) different bodily sites of experienced musculoskeletal pain.

To our knowledge, no other study has analyzed the two components of this newly developed model of psychosocial stress at work, the ratio of effort–reward imbalance and overcommitment, in relation to musculoskeletal pain. Our findings are in line with previous evidence documenting an important role of personal coping characteristics in explaining musculoskeletal pain, in addition to work environment-related stressors (Eriksen & Ursin, 1999). Although it is possible that musculoskeletal complaints affect the level of overcommitment, this is rather unlikely given a relatively high interpersonal stability over time of this pattern (Siegrist, 1996).

In physiological terms, musculoskeletal pain produced by overcommitment can be explained as a result of recurrent activation of low-threshold motor units in specific muscles after sustained activity of the autonomic nervous system (Lundberg, 1999; Westgaard, Holte, & Vasseljen, 2000). Previous studies showed that the more central regions of the body, especially neck and shoulder, are more vulnerable to enhanced tension and its adverse effects on musculoskeletal symptoms (Theorell, Harms-Ringdahl, Ahlberg-Hulten, & Westin, 1991; Toomingas, Theorell, Michélsen, & Nordemar, 1997; Westgaard, Jensen, & Hansen, 1993). In this context, it is interesting to note that the two components of the work stress model of effort–reward imbalance also are associated with musculoskeletal pain in more central bodily regions, such as neck and hip regions. Although it seems plausible to attribute hip pain to osteoarthritis, there is independent evidence of an association of psychosocial factors with hip pain (Wolfe, 1999).

Several limitations of this investigation must be mentioned. Because the study design is not prospective, no causal inference can be drawn. Furthermore, no objective measure of muscle tension (e.g., derived from electromyographic recordings) was available in investigating a healthy population at the worksite.

Although we applied a well-tested standardized questionnaire that differentiates between symptoms at different sites and in different time intervals, we were not able to explore the dynamics of pain perception, symptom reporting, and cognitive defense mechanisms that may be involved (Ursin & Eriksen, 2001). Thus, our data on musculoskeletal symptoms must be considered rather crude approximate measures of more varied and more subtle processes resulting in subjective health complaints. However, there is some indication of the validity of the mea-

sures of musculoskeletal pain used in this study. For instance, the prevalence rates that we observed were in accordance with the ones reported in previous investigations (Eriksen et al., 1999; Foppa & Noack, 1996; Magnusson et al., 1996; Riihimäki, 1999). In addition, our results are consistent with previously reported findings concerning associations of musculoskeletal symptoms with physical workload (Ariëns et al., 2000), low control at work (Theorell et al., 1991), and adverse work conditions such as shift work (Kleiven, Boggild, & Jeppesen, 1998; Koda et al., 1991; Ueda et al., 1989). Indirect evidence of the validity of the findings is given by the fact that psychosocial work stress as measured in this approach was associated with additional indicators of self-reported health complaints, such as depressive mood, general subjective health status, or sleep disturbances (results not shown in detail).

Because perceived work stress was measured only once, no inference on exposure over time can be made. Moreover, our measure of physical work demand was limited. This may have resulted in an underestimation of its contribution toward explaining musculoskeletal pain. Moreover, we did not test the full job demand–control model (Karasek et al., 1998) but restricted our measure to the component of control or decision latitude. This decision was made in view of some conceptual overlap between the two respective measures: the component of effort of the effort–reward imbalance model and the component of demand in the demand–control model.

A further limitation of this study is that the sample was limited in size (in particular, few employed women), and a selection bias cannot be ruled out. As mentioned, main reasons for participation were interest in supporting a scientific study, financial incentive, and personal concern about work and health. Even if we assume that this latter reason was the main driving force to participate, two opposite effects on results produced by this selection bias could be expected. On one hand, this may have contributed to an overestimation of the hypothesized effect, but on the other hand, the really exhausted and stressed employees and those with very busy schedules may have been underrepresented in the study sample.

In view of these limitations, further studies are needed to validate these findings. Larger samples would allow more complex statistical analyses such as tests of interaction terms between predicting variables, in particular the effort–reward imbalance ratio and overcommitment or interaction terms between psychosocial and physical workload. A better control of possible Type 1 error is needed as well as demonstration of effects in a prospective study design. Meanwhile, our group has started a much larger prospectively designed investigation in this important field of inquiry.

Despite the limitations discussed, this study documents associations of perceived work stress and the coping pattern overcommitment with musculoskeletal symptoms at different sites in an otherwise healthy, middle-age, employed popula-

tion. In view of an important role of musculoskeletal pain in absenteeism, our results underline the importance of implementing stress-reducing measures at work, at both the behavioral and structural level.

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APPENDIX
Short Version of the Overcommitment Questionnaire

Please indicate to what extent you personally agree or disagree with these statements. Thank you for answering all statements.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. I get easily overwhelmed by time pressures at work.	❑ (1)	❑ (2)	❑ (3)	❑ (4)
2. As soon as I get up in the morning I start thinking about work problems.	❑ (1)	❑ (2)	❑ (3)	❑ (4)
3. When I get home, I can easily relax and 'switch off' work.	❑ (1)	❑ (2)	❑ (3)	❑ (4)
4. People close to me say I sacrifice too much for my job.	❑ (1)	❑ (2)	❑ (3)	❑ (4)
5. Work rarely lets me go, it is still on my mind when I go to bed.	❑ (1)	❑ (2)	❑ (3)	❑ (4)
6. If I postpone something that I was supposed to do today I'll have trouble sleeping at night.	❑ (1)	❑ (2)	❑ (3)	❑ (4)