Can individual health differences be explained by workplace characteristics?—A multilevel analysis

Staffan Marklund, Malin Bolin, Jan von Essen

Abstract

Research on work-related health has mainly focused on individual factors. The present study expands the focus by exploring the role of organizational characteristics of workplaces for different individual health outcomes. The aim of the study was to look at differences in relative effect of workplace variations on five health outcomes, and to explain those differences in health outcomes by organizational characteristics. The sample encompassed 90 workplaces in Sweden and about 4300 individuals employed within these workplaces. Measurement of the workplace characteristics was carried out independently of the measurement of the individual's working conditions and health. Organizational data were collected by interviews with local managers at participating workplaces, and individual data were obtained by means of a survey of the employees. The results showed that a significant proportion of the variance in sickness absence, work ability, general health, and musculoskeletal disorders was attributed to the workplace. Of eight tested organizational characteristics, customer adaptation, lean production, and performance control could explain some of this workplace variance. The results also showed that only one organizational effect remained significant when controlled for the individual confounder of age and gender. High customer adaptation is associated with higher sickness absence. This association is not mediated via differences in mental and physical job strain.

Keywords: Organizational characteristics; Working conditions; Sickness absence; Musculoskeletal disorders; Work ability; General health; Sweden

Introduction

Some years ago, Susser and Susser (1996) argued that epidemiology has a 'black box problem'. Studies of different health outcomes have been successful in determining the risk ratio under different ecological conditions, but less capable of finding the mechanisms that explain the variation. Interpretations of the relationships between working conditions and health have often been ecological or structural, although empirical findings are based on individuals. Occupational position has been the main tools for understanding why health varies between groups of employees (Evans, Barer, & Marmor, 1994; Karasek & Theorell, 1990). The idea is workplace characteristics affect working conditions of people in different occupations, and
that such differences affect health. That is, workers employed at a workplace share the same context and are part of the same organizational structure, in which division of work, authority, and control strategies are the main dimensions (Child, 2005; Mintzberg, 1983; Robbins & Barnwell, 2002).

However, there is a lack of knowledge concerning what workplace characteristics are of importance. Apart from the fact that this limits the understanding of some major occupational health problems, it also restricts the possibility to prevent workplace-related disorders and ill health (Danna & Griffin, 1999; Greenland, 2001; Krieger, 1994; Morrison & Payne, 2003). In this study we try to assess the relationship between organizational characteristics of the workplace and individual health outcomes while controlling for working conditions and personal characteristics. Thus, the main question concerns the degree to which there are differences in the health of workers that can be located within the workplace; and if there are such differences, we are also interested in specific organizational characteristics that are related to health.

In accordance with the assumptions behind organizational health promotion theory (DeJoy & Wilson, 2003; Vandenbergh, Park, DeJoy, Wilson, & Griffin-Blake, 2002) and job redesign theory (Engbers, van Poppel, Paw, & Mecheleen, 2005; Karasek & Theorell, 1990; Michie & Williams, 2003) we assume that it is possible to distinguish between healthy and unhealthy organizations. In the same way we assume that organizational risk factors are mainly located in the structure of the workplace. However, none of these research areas have developed a theoretical framework in which characteristics of organizational structure are included. Therefore, organizational theories have been used to identify organizational characteristics.

The working conditions of the individual are closely intertwined with the organizational structure of the workplace. The way in which division of labor, authority, and control are organized decides how tasks are split into several jobs. Thus, each job is designed for a certain number of work tasks and holds certain privileges and responsibilities. A job can result in a stimulating amount of work tasks, providing good opportunities to make job-related decisions, or it can result in demeaning working conditions and high levels of job strain.

A review by Lundstrom and collaborators concludes that there is some evidence that organizational characteristics affect workers’ health (Lundstrom, Pugliese, Bartley, Cox, & Guither, 2002). Studies have also shown that decentralized authority has a positive impact on job satisfaction and well-being (Campbell, Fowles, & Weber, 2004; van den Berg, Landeweerd, Tummers, & van Merode, 2006; Way & MacNeil 2006).

Organizational characteristics are the means by which a certain organizational structure is accomplished. Weber’s model of bureaucracy has dominated earlier empirical studies of organizational structure as well as organizational theories (Thompson & McHugh, 2002). Empirical applications performed by the Aston school (Pugh et al., 1963; Pugh, Hickson, Hinings, & Turner, 1968, 1969) and others (Blau & Schoenherr, 1971; Child, 1973) measured the different dimensions of Weber’s model. Degree of role specialization, centralization, and formalization were used to measure of division of labor, authority, and control strategies (Pugh et al., 1963). Present day organizational theory and empirical studies are dominated by the opposite of bureaucracy (Alvesson & Thompson, 2005; Maravelias, 2002). This organizational structure has focused on flexibility and customer relations and has been given many names, such as the “flexible organization” (NUTEK, 1999) or the “Post-bureaucracy” (Alvesson & Thompson, 2005; Child, 2005; Dhondt et al., 2000; OECD, 1999; Osterman, 1994). An integrated division of labor accomplished by project organization, teams or functional flexibility, authority by decentralization, and control by self-regulation and quality control of final product or service rather than rule-following are common concepts (Child, 2005, p. 47; OECD, 1999; Peterson, 2005).

This organizational structure has generally been presented as resulting in favorable working conditions (Castells, 2000). Decentralized authority is assumed to give the individual employee increased autonomy and a division of labor characterized by integration offers the employee task variety and more qualified work. Multi-skilled employees can perform several jobs through extended professional roles and/or by learning a number of roles through functional flexibility (Atkinson, 1984). Another aspect of organization is access to resources (Pfeffer & Salancik, 1978). Several studies have shown that lack of resources, in terms of lean production, and downsizing, has a negative impact on health (Landsbergis, Cahill, & Schnall, 1999) and sickness absence (Kivimäki, Vahtera, Pentti, & Ferrie, 2000; Westerlund et al., 2004).
However, there are a number of methodological and theoretical complications in assessing the relationships between organizational conditions, working conditions and health (Kalleberg, 1994; Klein & Kozlowski, 2000; Mastekaasa, 1992).

One problem is related to the need for genuine organizational data on workplaces, on working conditions and on individuals’ health. By ‘genuine’ we mean that data at each ‘level’ are independent of each other to limit the risk for systematic bias when individuals assess their workplace conditions and their health. Most studies have based their information about the organization on surveys addressed to the employees and aggregated information about employee conditions, such as the age distribution of workers or the average view of workers on ‘leadership styles’. This not only limits the aspects of an organization that can be studied, but also introduces a risk of bias, in the sense that such studies report the worker’s perception of the organizational characteristics rather than the actual structure.

In several studies psychosocial working conditions are defined as organizational characteristics, although they are measured as individual conditions (Akerboom & Maes, 2006; Campbell, Fowles, & Weber, 2004; Marchand, Demers, & Durand, 2005). This means that each individual at a workplace has a unique set of workplace characteristics. This causes confusion about the conceptual difference between working conditions and workplace conditions. Kalleberg (1990, 1994) suggests a two-stage research design, where employees are asked about working conditions and key informants are asked about organizational conditions. This would ensure independent measures and more sophisticated dimensions.

A second, and often discussed problem, concerns at what level in an organization the relationships with working conditions and health can be found (Kalleberg, 1990; Klein, Dansereau, & Hall, 1994; Rousseau, 1985). There is a large variety of ‘levels’ in organizational studies, ranging from business conditions of large conglomerates down to the group level of individual workers. As all different levels of organizations may be important for specific research questions, it is necessary to give an explanation for the choice of level.

A number of recent studies have tried to link workplace characteristics to health by using multilevel analysis. Multilevel techniques are useful for simultaneous testing of relationships between characteristics at different levels, including the individual level. They allow for the study of the interplay between individual and workplace characteristics that may affect health. A number of articles have discussed the potential and limitations of multilevel analysis in the area of health (Bliese & Jex, 2002; Bryk & Raudenbush, 1989; Chen, Bliese, & Mathieu, 2005; Diez-Roux, 1998, 2002; Duncan, Jones, & Moon, 1998; Greenland, 2001; Klein, Dansereau, & Hall, 1994; Rousseau, 1985).

Most studies have looked at different aspects of psychosomatic health conditions such as stress, depression, or exhaustion. Bliese and Britt (2001) found that leadership climate predicted depression among soldiers. Relatively strong effects of workplace characteristics on psychosomatic complaints were found in a study in Sweden (Söderfeldt et al., 1997). A Dutch study dealing with similar questions, however, found that health may have different degrees of organizational dependency (van Veldhoven, de Jonge, Broersen, Kompier, & Meijman, 2002).

Other studies have shown that organization does not matter. One study found no support for the hypothesis that organizationally determined demands or control can explain variation in general health (Morrison, Payne, & Wall, 2003). A study examining the effect of group-based and individually based working conditions on emotional exhaustion, did not find any additional effects of the group-level variables (Tummers, van Merode, Landeweerd, & Candel, 2003). One study was able to establish organizational effects on working conditions but could not find a direct effect of organizational conditions on health (de Jonge, Breukelen, Landeweerd, & Nijhuis, 1999).

Organizational correlates to sickness absence have been found in several studies (Durand, 1985; Steers & Rhodes, 1984). However, only a few studies on absence have used a multilevel design. Van Yperen and Snijders (2000) found that the number of sick-days was affected by group level measured differences in job demands and job control. Similarly, one study showed that sickness absence was related to organization through individual working conditions (Elvoinio, Kivimäki, Steen, & Vahtera, 2004). One analysis concluded that the establishment effect (size, type of industry and geographical location) on sickness absence is as strong as the effects of individual factors (Arai & Skogman Thoursie, 2004). In this case there was no control for factors related to work environment, which may mean that some of the establishment effect reflects these differences. Such a control was
carried out by Labriola and collaborators and the workplace characteristics measured as aggregated psychosocial conditions remained significant (Labriola, Christensen, Lund, Lindhardt Nielsen, & Diderichsen, 2006).

In conclusion, the evidence on the direct link between workplace conditions and health is contradictory. A few studies have shown that workplace differences as such are related to health differences, but when competing hypotheses on individual working conditions are allowed into the causal model, less strong links can be seen. Different studies have also used different health indicators and different characteristics of the workplace. This obstructs comparability between studies.

The general idea behind the present study of the organizational impact on health outcomes is presented in Fig. 1.

The different health dimensions concern general health, musculoskeletal disorders, mental health, sickness absence and work ability. The workplace characteristics are primarily seen as structural conditions dealing with division of labor, authority, control strategies and resources. Working conditions are seen as mediators and individual conditions as confounders. Thus, the main idea is that health may be either directly associated with workplace characteristics or indirectly through physical or mental working conditions.

**Aims of the study**

The first aim of the study is to look at differences in the relative effect of workplace variation on the individual health outcomes: sickness absence, work ability, general health, mental health and musculoskeletal disorders.

The second aim is to test workplace characteristics that may be associated with differences in these health outcomes.

**Material and methods**

**Data collection**

Data were collected in Sweden between 2000 and 2003 (see Marklund, Berntson, Bolin, Härenstam, & Ylander, 2006 for details). The material consists of two sources of data: data on workplaces and on the individuals working within these workplaces. A two-stage sample was used. First, workplaces were asked to participate and second all individuals working within these workplaces were given the opportunity to participate in the study. The empirical definition of a workplace was that it must have one responsible manager, and constitute a separate accounting unit or profit center. Using this definition some of the large enterprises that were organized in separate departments were treated as separate workplaces (Bolin, Marklund, & Bliese, 2007). In some cases there were also sub-units, but no information was collected at this level. The workplaces stand for a broad variety of production activities rather than a representative sample of Swedish organizations or the Swedish labor force.

Fig. 2 shows the distribution of workplaces and individuals by type of industry.

The participating 90 workplaces included staff intensive manufacturing (7%), capital intensive manufacturing (3%), knowledge-intensive services (38%), welfare services (31%), and manual services
(21%). The size of the workplaces varies from 6 to 655 employees. Seventy-five of the workplaces have 50 employees or less. Sixty percent of the organizations are private enterprises, one third is in the public sector, and the rest are equally divided between cooperatives and public enterprises.

The collection of workplace data was conducted by structured interviews with operative managers at the participating workplaces, supplemented by documents and organizational charts. Two researchers conducted each interview; one with responsibility for the questioning and the other for writing and filling in the questionnaire. The interviews lasted generally for 2 h. Questions covered dimensions such as market position, the production process, authority structure, control systems, and occupational health and safety management. The questionnaire with references to other studies is published elsewhere (Marklund et al., 2006). The interview template was designed as a questionnaire with close-ended response choices mostly ranging from low (1) to high (3). To guarantee that the same definition was used for all the workplaces the criteria for each response choice was decided in advance, and each researcher classified each answer. When there was disagreement between the two researchers a third member of the research group was consulted to set the issue. After the interviews, each manager received a written copy of the interview. In the few cases of disagreement between the research team and the informant on classification of an individual answer the research team made the final decision. This decision was later confirmed by the informant in all cases.

The individual-level data collection consisted of a questionnaire on the employee’s physical and mental health status, as well as the physical and psychosocial work environment. All employees of the participating organizations received a questionnaire that was distributed by the organization’s occupational health service, to be filled in at home. The questionnaires were returned by mail and full anonymity was guaranteed to all respondents. A total of 4306 out of the 5293 employed individuals (81.4%) who received the questionnaire responded. There were no significant differences in response rate between the workplaces, nor between men and women. The participating individuals were between 18 and 66 years old ($M = 44$, $STD = 10.2$) and a majority were men (71%).

**Individual health outcomes**

Five health outcomes were chosen for analysis in order to cover several domains of health. They were all self-reported and included general health, sickness absence, mental health, musculoskeletal disorders, and work ability. General health was self-evaluated overall health status on a scale between 1 (very good) and 5 (very poor). Sickness absence describes the self-reported absence from work due to illness during the last 12 months. All kinds of
sickness absence were included whether work related or not. The available responses were: not at all (0), 1–7 days (1), 8–30 days (2), 31–90 days (3), more than 90 days (4). It was not possible to discriminate between different spells of sickness absence. Mental health was assessed with the General Health Questionnaire (GHQ12) (Bech, Gudex, & Staehr Johansen, 1996). For this index Cronbach’s $\alpha$ was 0.85. Musculoskeletal disorders were self-reported in seven items on the level of pain experienced in different parts of the body within the last 12 months. Cronbach’s $\alpha$ was 0.79 for this index. Work ability is assessed by the WAI index developed by Tuomi, Ilmarinen, Jahkola, Katjarinne, and Tulkki (1994).

**Measures of workplace characteristics**

The specific organizational characteristics that were explored in the present study mainly dealt with four broad organizational dimensions based on theory described above (Atkinson, 1984; Castells, 2000; Child, 2005; Mintzberg, 1983), and earlier empirical studies of organization (Gouwsuard, Dhondt, & Kraan, 1999; Härenstam, Bejerot, Leijon, Schele, & Waldenström, 2004; IMSS, 2001; le Grand, Szulkin, & Tåhlin, 1996; Wikman, 2001). The dimensions were division of labor, authority, control strategies, and resources. Division of labor concerns the degree of adjustment of production to customer needs and the use of functional flexibility. The authority dimension deals with decision making at the workplaces, while control strategies concern measurement by quantitative measures, and control by values and dialogue. Resources are seen in terms of availability of different resources. Each major dimension is an index composed of several specific organizational items. Altogether, eight organizational indexes were examined in relation to health. In Table 1 the different indexes and items are presented.

The main dimension control strategies include performance control and soft control systems. Performance control is an index of two items which assess the degree to which the workplace relies on result control, quantitative evaluations, and ISO-certification in order to achieve goals or increase production. The index Soft control systems describes how control is characterized by physical meetings between employers and employees and by use of conscious dialogues on values. Authority is described by individual responsibility, and group responsibility. Individual responsibility is a three-level factor. Each workplace was categorized depending on whether the individual is primarily responsible for (a) planning or evaluation of production, (b) planning and evaluation of production, or (c) neither planning nor evaluation of production. Similarly, group responsibility is a three-level factor which categorizes workplaces according to the amount of primary responsibility on the production team instead.

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**Table 1**

The range of four dimensions of organizational structure, the indexes constituting these characteristics and the specific items each index is based on, as well as correlations (Spearman) between items constituting the indexes

<table>
<thead>
<tr>
<th>Workplace characteristics</th>
<th>Min and max</th>
<th>Correlation</th>
</tr>
</thead>
</table>

**Division of labor**

| Functional flexibility (index) | 3–9 | Range 0.28**–0.43** |
| Job rotation | 1–3 |
| Job enrichment | 1–3 |
| Internal education | 1–3 |
| Customer adaptation (index) | 2–6 | 0.46** |

**Authority**

| Individual responsibility (index) | 2–4 | 0.55** |
| Individual responsible for planning | 1–2 |
| Individual responsible for follow-up | 1–2 |
| Group responsibility (index) | 2–4 | 0.49** |
| Group responsible for planning | 1–2 |
| Group responsible for follow-up | 1–2 |

**Control strategies**

| Performance control (index) | 2–6 | 0.28** |
| ISO-certification | 1–3 |
| Hard control systems | 1–3 |
| Soft control systems | 2–6 | 0.075** |

**Resources**

| Lack of resources (index) | 2–6 | Range 0.11**–0.46** |
| Materials resources | 1–3 |
| Administrative resources | 1–3 |
| Personnel resources | 1–3 |

**p < 0.01.**
Two aspects of the division of labor are described: functional flexibility, and customer adaptation. Functional flexibility is an index composed of three questions about job rotation, job enrichment, and in-house training. The index on customer adaptation is composed of two items measuring the degree of customer tailored production and degree of reciprocal communication with customers.

The index lack of resources includes four measures on how often the production suffers from lack of personnel, administrative, and material resources.

Confounders and mediators

Several variables at the individual level were considered as possible confounders. Gender and age were chosen because their relation to health outcomes and their variability between workplaces.

Physical and mental job strains were hypothesized to be mediators of relations between workplace characteristics and health. Physical job strain is a continuous index based on five questions on the occurrence of demanding working postures, and lifting or handling of heavy objects or persons in daily work. The questions originate from the MOA-study and have been tested for validity and reliability by Leijon, Wictorin, Härenstam, and Karlqvist (2002). The index had a Cronbach’s $\alpha$ of 0.81.

The mental job strain measure is based on job demands and control, which are two dimensions in the JD-C model (Karasek & Theorell, 1990). Job demands were measured through the Swedish version of five standard questions about workload, time pressure, and incompatible demands (“work very fast”, “work very hard”, “excessive work”, “enough time”, and “conflicting demands”). The response alternatives ranged from 1 (“No, never”) to 4 (“Yes, often”) and Cronbach’s $\alpha$ was 0.70. Control was assessed as a summary index of the four standard questions in the Swedish version for the two dimensions decision latitude (influence over how, and what) and skill utilization (skill, creativity, monotony). The response choices were the same as for “demands”, except with reversed scores, with Cronbach’s $\alpha$ being 0.65. Both job demands and control were well distributed. In order to assess job strain these measures were combined to one continuous index in which high values corresponded to high job strain. To avoid that the index value for high strain would include individuals with medium values on one of the two dimensions and extreme values on the other an absolute breakpoint was used. Job strain was defined as having at least a total of score of 28 out of 44 in this combination of high job demands and low job control. This means that the mean score on the 11 individual items was over 2.5. The combined index had a Cronbach’s $\alpha$ of 0.69.

Statistical methods

A two-level random coefficient regression approach was adopted for the statistical analyses (Hox, 2002; Snijders & Bosker, 1999). This was justified by the fact that individuals are nested within workplaces and is subject to contextual influences thereof. The software SPSS 14.0 for Windows was used for all analyses. Restricted maximum likelihood was used for parameter estimation in the multilevel models.

Some of the included predictors and outcomes were moderately skewed. In order to normalize the distributions, logarithmic transformations were carried out on sickness absence, mental health, and work ability among the outcome measures, and the predictor performance control. All measures were standardized by $z$-transformation in order to yield more interpretable parameters. Consequently, all measures were centered on the grand mean.

The analyses were carried out in sequential steps in order to describe both crude workplace differences and full models with significant predictors at both levels. Initially, a two-level model without predictors was fitted for each health outcome. These models generated the baseline distributions of variation between the individual level and the workplace level. Only outcomes with significant variation at the workplace level were further analyzed, since fixed effects of workplace characteristics are reflected only in workplace differences. This is indicated by the intra-class correlations (ICC).

Next, workplace predictors were included in order to explain the workplace differences found. Initial screening for potentially important predictors was conducted by correlation analysis for continuous indexes and by analyses of variance for categorical variables. Organizational characteristics that displayed an association ($p<0.10$) with a health outcome were included. Significant predictors were retained in the initial models to assess the crude associations between organization and health.
In a similar way, individual-level confounders were separately evaluated prior to inclusion in multivariate models. The fixed and random effects were estimated in random slope models for each individual-level predictor. These initial models were fitted with unstructured covariance matrices between random effects, i.e. the intercept-by-slope covariance was a free parameter. Only variance and covariance that was significant in these initial analyses were fitted in subsequent models. If a model with unstructured covariance matrices between random effects did not converge, then a diagonal matrix was fitted instead. Cross-level interactions were examined when a significant random effect was found for a predictor, in which case all possible cross-level interactions were estimated between the individual confounder and all of the workplace predictors included in the present study. No within-level interactions were tested.

The adjustments of crude associations between workplace characteristics and health were conducted in two steps. First, for each pair of outcome and significant predictor at the workplace level, a model was fitted including significant effects of age and gender at the individual level as well as significant cross-level interactions. Second, if the effect of the workplace predictor remained significant, the effects of physical and mental job strain were added together with cross-level interactions. The reason for the two-step approach was a theoretical differentiation between age and gender being confounders, and aspects of job strain being mediators.

Finally, if more than one workplace characteristic remained a significant predictor for a single health outcome, all of them were included in a single model, together with all individual covariates and cross-level interactions. This was done in order to conclude whether the workplace predictors are independent of each other or not.

Results

The crude associations between workplace characteristics and health

The potential impact of workplace characteristics on health was estimated in an empty multilevel model for each health outcome. Table 2 shows the between-workplace variations for all health outcomes.

Table 2
Standardized intra-class correlations (ICC) for the 90 workplaces and 95% confidence intervals (CI) for different health outcomes

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>ICC</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>General health</td>
<td>0.011*</td>
<td>0.005–0.026</td>
</tr>
<tr>
<td>Sickness absence</td>
<td>0.023**</td>
<td>0.011–0.046</td>
</tr>
<tr>
<td>Mental health</td>
<td>0.014</td>
<td>0.000–0.041</td>
</tr>
<tr>
<td>Musculoskeletal disorders</td>
<td>0.040***</td>
<td>0.022–0.074</td>
</tr>
<tr>
<td>Work ability</td>
<td>0.029**</td>
<td>0.015–0.058</td>
</tr>
</tbody>
</table>

*p < 0.05.
**p < 0.01.
***p < 0.001.

A significant amount of variation between workplaces was found for general health, musculoskeletal disorders, sickness absence, and work ability. This means that workplace characteristics may be significant for predicting these outcomes. There is a range between 4% for musculoskeletal disorders and 1.1% for general health that can be attributed to the workplace level. The levels of mental health did not vary significantly between workplaces. Mental health was further analyzed to test for possible interactions, but none was found significant, and the variable was dropped.

Workplace differences and differences in health

In the next step, screening for the predictors was conducted by correlation analysis. Musculoskeletal disorders were correlated to performance control, group responsibility and lack of resources (Table 3). Sickness absence was correlated to individual responsibility, group responsibility, functional flexibility and customer adaptation. Work ability was correlated to performance control, and lack of resources.

Adjusted relationships

In the third step regression analyses were conducted. Three, out of the tested eight, organizational characteristics were found significant for explaining the demonstrated workplace differences (Table 4).

A high level of performance control at a workplace was associated with a low degree of musculoskeletal disorders and high work ability. A high level of customer adaptation was associated with high sickness absence. Also, lack of resources was associated with low work ability. Regarding general
health, none of the examined organizational characteristics was able to account for a significant part of the between-workplace variation.

Age, gender, physical and mental job strain, were analyzed in separate random slope models for effects on health outcomes. All four of them demonstrated significant fixed effects on all of the outcome measures (data not shown). Furthermore, a random variance was found for age in predicting work ability. This indicates that the relationship between age and work ability varies between workplaces, which may be explained by cross-level interactions.

In order to estimate effects of the workplace characteristics independent of the individual founders, multilevel regressions including age and gender at the individual level and workplace characteristics were modeled for each health outcome. Because work ability was associated with two workplace variables (performance control and lack of resources), two separate regressions were also modeled. As none of these factors remained significant after inclusion of confounders no further modeling was needed.

Cross-level interactions between age and each of the workplace characteristics explored in the present study were estimated for possible inclusion in the model predicting work ability. No significant interactions were found, but the random effect of age was retained in the model (results not shown). Table 4 displays these adjusted effects of organization. The results showed that the differences in age and gender distributions between workplaces accounted for all crude associations between organization and health, except for the effect of customer adaptation on sickness absence.

Finally, the fixed effects of physical and mental job strain were included in the model for predicting sickness absence. This was done to determine whether the effect of customer adaptation was mediated through working conditions. The independent effect of customer adaptation for predicting sickness absence was not further attenuated in this model ($\beta = 0.062, p < 0.05$).

Table 5 shows the parameter estimates in the final model for each outcome. The intercept variances indicate that significant workplace differences remain only in sickness absence, among the studied health outcomes. This remaining difference can be

Table 3
 Pearson correlation coefficients and $F$ values for the associations between workplace characteristics and individual health outcomes

<table>
<thead>
<tr>
<th></th>
<th>General health</th>
<th>Sickness absence</th>
<th>Musculoskeletal disorders</th>
<th>Work ability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional flexibility²</td>
<td>0.030*</td>
<td>0.057****</td>
<td>-0.005</td>
<td>0.008</td>
</tr>
<tr>
<td>Customer adaptation²</td>
<td>0.028*</td>
<td>0.065****</td>
<td>0.016</td>
<td>0.001</td>
</tr>
<tr>
<td>Individual responsibility²</td>
<td>1.30</td>
<td>3.12**</td>
<td>1.95</td>
<td>2.34*</td>
</tr>
<tr>
<td>Group responsibility²</td>
<td>2.76*</td>
<td>7.09****</td>
<td>3.04**</td>
<td>2.11</td>
</tr>
<tr>
<td>Performance control²</td>
<td>0.019</td>
<td>0.006</td>
<td>-0.060****</td>
<td>0.060****</td>
</tr>
<tr>
<td>Soft control systems²</td>
<td>-0.011</td>
<td>0.010</td>
<td>-0.020</td>
<td>-0.003</td>
</tr>
<tr>
<td>Lack of resources²</td>
<td>0.000</td>
<td>0.018</td>
<td>0.040***</td>
<td>-0.062****</td>
</tr>
</tbody>
</table>

*p < 0.10.  
**p < 0.05.  
***p < 0.01.  
****p < 0.001.

²Pearson correlation coefficients.  
²F-values.

Table 4
 Crude and age and gender adjusted standardized $\beta$ for the significant associations between workplace characteristics and health outcomes

<table>
<thead>
<tr>
<th>Bivariate association</th>
<th>Crude $\beta$</th>
<th>$\beta$ adjusted for age and gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sickness absence predicted by customer adaptation</td>
<td>0.070*</td>
<td>0.056*</td>
</tr>
<tr>
<td>Musculoskeletal disorders predicted by performance control</td>
<td>-0.071**</td>
<td>-0.011</td>
</tr>
<tr>
<td>Work ability predicted by performance control</td>
<td>0.081**</td>
<td>0.037</td>
</tr>
<tr>
<td>Work ability predicted by lack of resources</td>
<td>-0.061*</td>
<td>-0.038</td>
</tr>
</tbody>
</table>

*p < 0.05.  
**p < 0.01.
explained by workplace characteristics as well as individual characteristics that have not been examined in the present study.

**Discussion**

There are significant unadjusted workplace effects on four of the five health outcomes that were tested. Sickness absence, work ability, general health and musculoskeletal disorders are related to workplace differences. For the mental health indicator there was no significant effect of workplace differences in this study.

The study also shows that of the eight workplace characteristics that were tested to assess this variation in health outcomes, only three proved to be of significance. A high level of customer adaptation of the production was associated with an elevated level of sickness absence. Lack of resources was associated with a lower level of work ability. A high degree of performance control was associated with lower work ability as well as with a lower degree of muscular disorders. When possible disturbances from the confounders ‘age’ and ‘sex’ and the modifiers ‘physical strain’ and ‘mental strain’ at work were included, only one relationship remained significant. The factor *high degree of customer adaptation* was associated with an elevated level of sickness absence.

The fact that a high level of customer adaptation of the production process is associated with sickness absence can be seen in different ways. It means that even among employees with relatively favorable working conditions, there is an elevated risk for absenteeism at workplaces where the production is customer adjusted or based on a high degree of customer communication. Although no known study have specifically studied the importance of customer adaptation, the results are in accordance with previous research showing the organizational impact on sickness absence (Elovainio et al., 2004; Labriola et al., 2006; Van Yperen & Snijders 2000). The results may be particularly relevant for human services where customer adjustment and communication are focal organizational characteristics (Söderfeldt et al., 1997). Emotional demands on the employee has been shown to be an important aspect of customer adjustment, specifically in the service sector (Söderfeldt et al., 1997; Wharton, 1993). The present study also shows that different health outcomes have different relationships to workplace characteristics, and that the effect is relatively weak, which is also in line with results from other multilevel studies of health outcomes (de Jonge et al., 1999; Söderfeldt et al., 1997).

The results have different implications for the understanding of health. It can be argued that health is generally indirectly, but not directly, determined by organizational characteristics. The link is indirect in the sense that working conditions that affect health are related to organizational factors, and health itself has a more complex

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Health outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>General health</td>
</tr>
<tr>
<td>Intercept</td>
<td>−0.021</td>
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<tr>
<td>Intercept variance</td>
<td>0.006</td>
</tr>
<tr>
<td>Residual variance</td>
<td>0.945***</td>
</tr>
<tr>
<td><strong>Individual differences</strong></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.109***</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Psychological job strain</td>
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</tr>
<tr>
<td>Physical job strain</td>
<td>0.070***</td>
</tr>
<tr>
<td>Workplace differences</td>
<td></td>
</tr>
<tr>
<td>Customer adaptation</td>
<td>0.062*</td>
</tr>
<tr>
<td>Slope variance for age</td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05.

**p<0.01.

***p<0.001.
etiology. Another line of looking at the results is related to the specific nature of the data set. In a previous study, using the same data set, we have shown that the organizational effect differs with regard to organizational level (Bolin et al., 2007). Thus, health may be correlated with factors at a higher organizational level such as the enterprise as well as at a lower organizational level such as the work group. Hence, organizational effects on health may exist on different levels of organization and thus be underestimated in this study, where only the workplace level was studied.

Limitations and concluding remarks

The limitations of the present study are of different kinds. The fact that the material is not longitudinal makes it unsuitable for causal conclusions. Ideally a design where the organization is followed over time would not only allow safer conclusions about causality but also give an opportunity to study how organizational structures change.

Secondly, although workplace characteristics and individual health outcomes were measured independently, the indicators emanate in both cases from individual answers which are affected by personalities and a degree of subjectivity. Despite the ambition to get factual information rather than attitudes on workplace characteristics and although several informants were often used in the same workplace to validate information one cannot disregard the problem of information bias.

Another limitation is related to the selection of workplaces. The 90 workplaces are reasonably representative of different types of industries and the only missing major branch is retail trade. Thus, the sample is not representative in terms of the distribution of employees for example in terms of occupation or gender. Due to the composition of different workplaces there were more men than women in the study. This means that generalization to entire workforce should be made with caution.

On the other hand, we have included all employees at the workplaces instead of focusing on core employees. This means that the workplaces are heterogeneous in terms of occupations and working conditions. The effect of having a heterogeneous sample of this kind is that some calculations of the relationships between workplace characteristics and individual outcomes may be underestimated.

A final limitation is concerned with the necessarily limited selection of workplace characteristics used in the study. A large number of workplace characteristics have been tested, but it is possible that other indicators would have resulted in different conclusions. Some studies have indicated that characteristics such as leadership styles and organizational cultures might be more directly related to health (Bliese & Britt, 2001). On the other hand, it could be argued that both leadership and organizational cultures constitute a different kind of explanatory category. Leadership and cultures are not only organizationally determined but highly dependent on how individuals behave and how they are related to one another.

The results of this study indicate that organization matters for some aspects of health, but there is a need for further empirical studies of the relationship between workplace characteristics and health. In order to better clarify what workplace characteristics might be of importance, future research should be based on more complex models and theories of health. Particularly, the fact that the present study did not measure emotional demands is a shortcoming since such demands may be an important part of customer adaptation for some of the employees in the sample.

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