The interactions between pain, pain-related fear of movement and productivity

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Background Employees with physically heavy work have an increased risk of musculoskeletal disorders leading to reduced work ability.

Aims To investigate if a high level of musculoskeletal pain or pain-related fear of movement was associated with low productivity among employees with physically heavy work and differing work ability levels.

Methods The study was conducted at a Danish production site and employees with physically heavy work in the production line were included in the study. Work ability was assessed with the Work Ability Index (WAI), pain-related fear of movement with the Tampa Scale for Kinesiophobia and productivity and musculoskeletal pain by self-reported measures. Sickness absence records for construction of WAI were obtained from the workplace.

Results There was a 77% response rate with 350 employees included in the final analysis. Among employees with only moderate work ability, there was neither an association between pain and productivity nor between pain-related fear of movement and productivity. For employees with good work ability, higher levels of pain and higher levels of pain-related fear of movement both raised the odds of low productivity significantly.

Conclusions Despite the fact that musculoskeletal pain increases the risk of reduced work ability significantly, musculoskeletal pain and pain-related fear of movement were associated with low productivity only among employees with good work ability.

Key words Kinesiophobia; musculoskeletal pain; productivity; work ability.

Introduction Employees with physically heavy work have an increased risk of developing reduced work ability [1–3]. Reduced work ability is often a gradual process, implying that employees remain active in the labour market in spite of reduced work ability [1,4]. It may be difficult for employees to adjust their work situation and job demands to current work ability, and earlier studies have shown that reductions in work ability are associated with lower productivity [5,6]. Among employees with physically heavy work, the risk of both musculoskeletal pain and reduced work ability is increased [7–9], and musculoskeletal pain has also been associated with reductions in productivity [10,11]. The interrelatedness of work ability, productivity, pain and pain coping abilities is, therefore, of particular interest to employees with physically heavy work who wish to remain active in the labour market.

In a study by Jørgensen et al. [12], the pain coping abilities of a working population with physically heavy work were improved in the short term through cognitive therapy, without any effects on work ability. In this study, the Tampa Scale for Kinesiophobia (TSK) [13,14] was used for measuring pain coping abilities. A high score on the scale is indicative of fear of movements and training activities due to fear of injury or re-injury. The scale was originally developed for low back pain patients [15] but has later been tested in the general population [16] as well as in an occupational setting [17]. The results from these studies showed that TSK can be applied in populations other than chronic pain patients and that kinesiophobia can be found in all populations.
Kinesiophobia has been shown to predict chronic pain [18], disability in regard to performing activities of daily living [19] and sick leave [20]. Moreover, reductions in kinesiophobia have been shown to correlate with reductions in disability [21]. Pain-related fear interferes with cognitive functioning in a way that makes an individual more attentive to pain-related threats and less likely to apply active coping strategies [22,23]. The effects of kinesiophobia on work performance among workers with chronic nonspecific pain were assessed in a study by de Vries et al. [24], without significant results. No associations were found between scores on the Tampa Scale and work performance. However, higher work performance was associated with higher pain self-efficacy beliefs as measured by the Dutch version of the Pain Self Efficacy Questionnaire [25]. In this study, no analytical distinction was made between the workers’ work ability levels. Moreover, studies performed among individuals with musculoskeletal diagnoses have shown a relation between physical capacity and fear of movement in some types of tests, but not in others. See Reneman et al. [26] for a discussion. Accordingly, it is possible that kinesiophobia might not affect the productivity of employees still active in the labour market, but the interrelationship with work ability is not established with certainty.

The aim of this study was to investigate to what degree a high level of musculoskeletal pain or pain-related fear of movement is associated with low productivity in employees with physically heavy work and differing work ability levels.

**Methods**

Work ability was measured using the Work Ability Index (WAI) [27], consisting of seven dimensions: (i) current work ability; (ii) work ability in relation to job demands; (iii) number of current diseases; (iv) work impairment due to diseases; (v) sick leave during past 12 months; (vi) own prognosis of work ability in next 2 years and (vii) mental resources. The question on productivity was posed as follows: ‘How will you estimate your general work productivity for the last month?’ Answers were given on a 1–10 scale. Coping behaviour was assessed using a 13-item version of the TSK [28]. Musculoskeletal pain was measured as level of pain intensity on a 0–10-point scale. The question was only answered if the respondent had experienced pain within the last 7 days. The following body regions were included: neck, shoulders, elbows, hands, back, lower back, hips, knees and feet. Number of pain regions with pain intensity 4 or above on the 10-point scale was calculated, as well as maximum pain intensity in any of the mentioned body regions. Physical activity in leisure is considered an individual determinant of work performance [29] and was thus included in the analysis as a control variable. Physical activity in leisure was measured using four categories: Level 1, training at a competitive level for >4 h a week; Level 2, high-intensity exercise in 2–4 h a week; Level 3, light exercise for 2–4 h a week; Level 4, light physical activity for <2 h a week. The question was recoded into a dichotomous variable with 1 representing Levels 1 and 2 (high physical activity level in leisure) and 0 representing Levels 3 and 4 (low physical activity level in leisure).

The study population consisted of employees on a Danish production site with a high degree of heavy, repetitive work. Data were collected on September 2006 before the onset of an ergonomic intervention. An extensive questionnaire [30] was distributed at the workplace, and the employees were given the opportunity to answer the questionnaires during the working time. Based on information from the payroll, employees in the administrative unit were excluded from the analyses since the study only concerned employees with physically heavy work. The score on the TSK was constructed and Cronbach’s α as well as item-to-total correlations were calculated. Cronbach’s α had a value of 0.83 and none of the item-to-total correlations were <0.30. This indicates sufficient internal consistency. Correlation analysis using Kendall’s τ was used for testing the general relationship between TSK, productivity, work ability (WAI scores) and musculoskeletal pain. WAI scores were initially divided into four categories according to number of points: poor (7–27 points), moderate (28–36 points), good (37–43 points) and excellent (44–49 points). Since only one employee was in the category of poor work ability, the groups were further collapsed into two groups, one consisting of those with poor and moderate work ability and another consisting of those with good and excellent work ability. Ordinary logistic regression analysis was used for estimating the outcome low productivity (1–7 points on the productivity scale). Explanatory variables were age, gender, education, physical activity in leisure, pain intensity and score on the TSK. Initially, correlation analyses were performed on all explanatory variables. The estimation method was maximum likelihood and statistical software was SAS 8.2, the logit procedure. Results are presented in odds, expressing the change in the odds of reporting low productivity for a one point increase in the explanatory variable.

**Results**

The study population consisted of 478 employees and 448 returned the questionnaire (77%). Thirty-five (8%) employees worked in the administrative unit and were, therefore, excluded from the analyses. Due to missing data on single questions in the WAI or other variables in the analyses, the study base ended up consisting of 350 employees doing physically heavy work. The majority of the employees, 63%, had good work ability according to WAI (n = 220) and 37% had moderate work ability (n = 130). The average age was 43 years with no difference between those with poor or moderate work
ability (from now on defined as moderate work ability) and those with good work ability. See Table 1 for further descriptive measures. Correlation analyses were performed on TSK, productivity, work ability and musculoskeletal pain for the study group together, and repeated for the subgroups of employees with moderate ability and good work ability, as shown in Table 2. For the population as a whole (the upper part of Table 2), there was a positive relationship between work ability and productivity (\( \rho = 0.24, P < 0.001 \)). The correlation between TSK and productivity was (\( \rho = -0.09, P < 0.05 \)), indicating a negative relationship between kinesiophobia and productivity. There was no significant relationship between TSK and pain intensity. Between pain intensity and WAI score, there was a significant negative relationship (\( \rho = -0.31, P < 0.001 \)), and between pain intensity and productivity, the relationship was negative and significant (\( \rho = -0.13, P < 0.01 \)). There was no significant correlation between work ability and productivity or between TSK and productivity for employees with either good or moderate work ability (Table 2). Six sets of regression analyses were subsequently performed: three with inclusion of the score of the TSK (Model 1) and three including the maximal intensity of musculoskeletal pain (Model 2).

In Model 1 (Table 3), none of the explanatory variables showed any significance for employees with moderate WAI. For employees with good WAI, a high level of physical activity in leisure was associated with a decrease in the odds of being in the low productivity group by 88% (\( P < 0.05 \)) compared to a low level of physical activity in leisure. Moreover, the odds of being in the low productivity group increased by 8% for each point increase in TSK (\( P < 0.05 \)). In Model 2 (Table 4), as in Model 1, none of the explanatory variables were significant for employees with moderate WAI. For those with a good work ability according to WAI, a low physical activity level in leisure was associated with an increase in the odds of being in the low productivity group of 64% but this was not significant. The odds of being in the low productivity group increased by 19% (\( P < 0.05 \)) for each point increase in maximal intensity of musculoskeletal pain.

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**Table 1.** Means and ranges of age, work ability, TSK, productivity, number of body regions with musculoskeletal pain and maximum pain intensity as well as proportion of males and employees with a vocational education divided on work ability levels according to WAI

<table>
<thead>
<tr>
<th></th>
<th>All (n = 350)</th>
<th>Moderate work ability (n = 130)</th>
<th>Good work ability (n = 220)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years (mean, range)</td>
<td>43 (15–61)</td>
<td>43 (21–61)</td>
<td>42 (15–60)</td>
</tr>
<tr>
<td>Gender (% male)</td>
<td>88</td>
<td>86</td>
<td>90</td>
</tr>
<tr>
<td>Vocational, or other, education with duration 1 year + (%)</td>
<td>81</td>
<td>82</td>
<td>81</td>
</tr>
<tr>
<td>Mean work ability (mean, range)</td>
<td>37 (27–43)</td>
<td>34 (27–36)</td>
<td>39 (37–43)</td>
</tr>
<tr>
<td>TSK n = 313/124/189 (mean, range)</td>
<td>24 (13–51)</td>
<td>24 (13–49)</td>
<td>23 (13–51)</td>
</tr>
<tr>
<td>Productivity (mean, range)</td>
<td>8 (2–10)</td>
<td>8 (2–10)</td>
<td>9 (2–10)</td>
</tr>
<tr>
<td>Maximum pain intensity (mean, range)</td>
<td>4 (0–10)</td>
<td>5 (0–10)</td>
<td>3 (0–10)</td>
</tr>
<tr>
<td>Number of pain regions (mean, range)</td>
<td>1 (0–9)</td>
<td>2 (0–9)</td>
<td>1 (0–6)</td>
</tr>
</tbody>
</table>

**Table 2.** Correlation analysis: WAI, TSK, productivity, maximum pain intensity and number of pain regions

<table>
<thead>
<tr>
<th></th>
<th>TSK</th>
<th>Productivity</th>
<th>Maximum pain intensity</th>
<th>Number of pain regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>All (n = 309)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAI</td>
<td>-0.08 (NS)</td>
<td>0.24 (P &lt; 0.001)</td>
<td>-0.31 (P &lt; 0.001)</td>
<td>-0.28 (P &lt; 0.001)</td>
</tr>
<tr>
<td>TSK</td>
<td>1.0</td>
<td>-0.09 (P &lt; 0.05)</td>
<td>0.05 (NS)</td>
<td>0.06 (NS)</td>
</tr>
<tr>
<td>Productivity</td>
<td></td>
<td>1.0</td>
<td>-0.13 (P &lt; 0.01)</td>
<td>-0.10 (P &lt; 0.05)</td>
</tr>
<tr>
<td>Maximum pain</td>
<td></td>
<td></td>
<td>1.0</td>
<td>0.75 (P &lt; 0.001)</td>
</tr>
<tr>
<td>Moderate WAI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAI</td>
<td>-0.11 (NS)</td>
<td>0.12 (NS)</td>
<td>-0.32 (P &lt; 0.001)</td>
<td>-0.23 (P &lt; 0.01)</td>
</tr>
<tr>
<td>TSK</td>
<td>1.0</td>
<td>-0.01 (NS)</td>
<td>0.00 (NS)</td>
<td>0.01 (NS)</td>
</tr>
<tr>
<td>Productivity</td>
<td></td>
<td>1.0</td>
<td>-0.05 (NS)</td>
<td>0.02 (NS)</td>
</tr>
<tr>
<td>Maximum pain</td>
<td></td>
<td></td>
<td>1.0</td>
<td>0.68 (P &lt; 0.001)</td>
</tr>
<tr>
<td>Good WAI</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAI</td>
<td>-0.04 (NS)</td>
<td>0.07 (NS)</td>
<td>-0.04 (NS)</td>
<td>-0.01 (NS)</td>
</tr>
<tr>
<td>TSK</td>
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<td>-0.11 (NS)</td>
<td>0.06 (NS)</td>
<td>0.07 (NS)</td>
</tr>
<tr>
<td>Productivity</td>
<td></td>
<td>1.0</td>
<td>-0.02 (NS)</td>
<td>-0.001 (NS)</td>
</tr>
<tr>
<td>Maximum pain</td>
<td></td>
<td></td>
<td>1.0</td>
<td>0.75 (P &lt; 0.001)</td>
</tr>
</tbody>
</table>

NS, not significant.
Correlation coefficients and significance levels (\( P < 0.5 \)).
Since there were twice as many employees with good work ability as employees with moderate work ability, the statistical significance levels may reflect this. Therefore, the analyses for employees with good work ability were repeated using the sample size of the group of employees with moderate work ability (n = 122/130). This was accomplished by removing individuals from the sample of employees with good work ability in the order by which they had been assigned observation numbers at study baseline. Another potential threat to the validity of the statistical results stems from the fact that employees with moderate work ability had a slightly lower productivity level than employees with good work ability. When estimating the risk of reporting less than average productivity (8 points) and when comparing within the group of employees with moderate work ability, one should take into account that the average productivity of all employees may be a relatively high threshold for these employees and the analyses could be adjusted accordingly. The analyses were, therefore, repeated for those with moderate work ability and with low productivity, which is now defined as 6 or less.

Repeating the analyses for employees with good work ability using a reduced sample size (n = 122/130) yielded the result that pain intensity was still significantly associated with low productivity. A one point increase in maximal pain intensity was now associated with an increase in the odds of low productivity by 22% (P < 0.05). The association between TSK and low productivity was no longer significant. The results of the second set of sensitivity analyses based on employees with moderate work ability showed that neither pain intensity nor TSK had any effects on the odds of
reporting low productivity even if low productivity was defined as 6 points or less.

Discussion

This study found that work ability and musculoskeletal pain were interrelated issues for employees with physically heavy work. The correlation between work ability and musculoskeletal pain was negative and highly significant. Despite this, it was only among employees with good work ability that musculoskeletal pain and pain-related fear of movement were associated with low productivity.

One of the limitations in this study was sample size. Therefore, more studies are needed in order to get a more detailed picture of how employees with physically heavy work cope with musculoskeletal pain and manage their daily work. However, since the questionnaires used to assess work ability and kinesiophobia are quite extensive, larger studies on these topics may be difficult to perform. Another weakness of the study was that productivity could only be measured using a single question. It resembles the question used for measuring work performance in Pronk et al. [29], with good results. Furthermore, the work is repetitive, with the same daily tasks, and thus a less advanced measure of productivity seemed adequate.

There may be different explanations for the finding that musculoskeletal pain and kinesiophobia only were associated with low productivity among employees with good work ability. One possibility is that employees with reduced work ability may have adopted a higher threshold in regard to pain before it affects activity levels at work. In addition, they could have developed individual work routines so that their pain does not affect their productivity level. Finally, they may have developed reduced work ability due to a lack of adequate response towards pain. Reneman et al. [26] found similar results in his study of low back pain patients. He evaluated the functional capacity of the patients by asking them to perform a series of work-related physical activities (lifting, carrying etc.) to their maximum capabilities. The results were then correlated to TSK-17 [14] and musculoskeletal pain. The analyses showed no correlation between either pain and TSK or functional capability and TSK.

In conclusion, this study showed that reduced productivity is associated with pain-related fear of movement and musculoskeletal pain among employees with good work ability. Among employees with low work ability, we found no associations between pain-related fear of movement, musculoskeletal pain and productivity. This indicates that among employees with low work ability and high physical job demands, pain-related fear of movement may not be the optimal target for an intervention aiming at maintaining work ability. Finally, as also found in other studies, the results indicate that work ability and musculoskeletal pain are interrelated issues for employees with high physical job demands emphasizing the need for effective preventive initiatives.

Key points

- Work ability and musculoskeletal pain are interrelated issues for employees with high physical job demands, emphasizing the need for effective preventive initiatives.
- Among employees with lower work ability and high physical job demands, we found no associations between pain-related fear of movement, musculoskeletal pain and productivity.
- Pain-related fear of movement may not be the optimal target for an intervention aimed at maintaining the work ability of production workers.

Funding

The data collection and data analyses of the study were supported by a grant from the Danish Working Environment Foundation.

Acknowledgements

The study was a part of the FINALE programme. The authors thank physiotherapist Anni Vindnæs for her work on achieving the data for this article.

Conflicts of interest

None declared.

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