



## Time-course of occupational psychological and social factors as predictors of new-onset and persistent neck pain: A 3-wave prospective study over 4 years

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Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

### ARTICLE INFO

#### Article history:

Received 16 September 2013

Received in revised form 19 March 2014

Accepted 27 March 2014

Available online xxx

#### Keywords:

Psychosocial

Occupational

Neck pain

Musculoskeletal disorders

Longitudinal

Trajectory model

### ABSTRACT

The current study estimated the impact of psychological and social work factors over time on neck pain. A sample of Norwegian employees ( $n = 1250$ ) was surveyed on 3 occasions spanning 4 years. Five exposures were studied: quantitative demands, decision control, social climate, empowering leadership, and role conflict. Group-based trajectory models suggested factors changed little over time—employees could be classified by mean levels of exposure into groups exhibiting stable “high”, “middle”, and “low” levels. The exception was decision control, for which a 4-level classification was derived: “high”, “high–middle”, “low–middle”, and “low”. Pain prevalence at the end of the study period was compared across groups. Risk and prognosis were also assessed separately by dividing the sample according to pain status at baseline. For all factors, distinct differences in risk were observed between exposure groups, controlled for pain at baseline, skill level, sex, and age. Statistically significant effects ranged from 0.38 (CI 0.20–0.73,  $P < 0.01$ ) for high social climate to 3.00 (CI 1.63–5.50,  $P < 0.01$ ) for high role conflict. The risk of new-onset pain was predicted by all factors. ORs ranged from 0.32 (CI 0.16–0.67,  $P < 0.01$ ) for high empowering leadership to 2.61 (CI 1.09–6.21,  $P < 0.05$ ) for high role conflict. Pain persistence was predicted by high role conflict (OR 3.26, CI 1.30–8.18,  $P < 0.05$ ), high quantitative demands (odds ratio [OR] 3.66, CI 1.58–8.49,  $P < 0.01$ ), and high–middle decision control (OR 0.45, CI 0.21–0.99,  $P < 0.05$ ). Future studies should collect information at multiple time points to clarify the impact of prolonged and changing exposure on musculoskeletal pain.

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### 1. Introduction

Numerous studies have demonstrated that psychological and social work factors, typically measured at one occasion, can predict musculoskeletal pain disorders such as neck and back pain [2,3,5,19,25,26,44]. Nevertheless, results are not entirely consistent across studies [3,16]. The time-course of work factors has rarely been analyzed. If the duration of exposure is indeed important to the pathogenesis of work-related pain, the interpretability of previous studies may have been affected. The current study aimed to assess the effect of different courses of exposure on the occurrence of neck pain after 4 years.

Putative health effects of nonphysical occupational factors are often explained by “stress” paradigms [10]. One key assumption is that *sustained* mental “load” can be pathogenic [10,28,33]. While classic “stress” theories also consider dramatic life events [18] and acute, potentially life-threatening, “stressors” [37], the psychological challenges of contemporary work life do not typically entail such events. Theoretical models such as the demand/control model [20] pertain to challenges hypothesized to influence health when encountered *regularly* [21]. However, despite such “chronic exposure” notions, surprisingly few studies have examined psychological work factors *over time*. Recently, Ganster and Rosen [13] reviewed literature relating psychological work factors to health, noting that “chronic exposures over the course of several years show greater risk than consistently low or inconsistent exposures” (p. 27). They concluded that assessing exposure over multiple time points is advisable but remains uncommon.

Prospective studies often draw information from 2 waves of data to estimate lagged effects. Hypothesized cause and effect

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can be temporally separated by predicting new-onset pain from previous exposure. A recent meta-analysis comprising 50 studies of psychological work factors concluded that most factors exhibited “small but significant lagged effects on the development of musculoskeletal problems” [23] (p. 1163). This is indicative of causality, but effects may be underestimated or undetected. Alleviated exposure during the study period may result in restored health. Since the psychophysiological pathogenesis of musculoskeletal pain is unclear, it is difficult to time the measurement of exposures and health at pathogenically accurate intervals. Some hypotheses have suggested that pain originates from ongoing muscle-cell activity resulting in energy crisis [15]. Others have proposed that pain is mediated by factors involved in regulating the circulation during psychological challenge [22]. We do know that neck pain can develop rapidly during simulated office work [43]. In theory, pain disorders may develop from: (1) acute trauma or overuse exposure producing inflammatory response and pain that is maintained by peripheral or psychophysiological mechanisms; or (2) continuous or frequent exposures subjecting peripheral and central nervous mechanisms to sustained load. The common reliance on single-exposure assessments suggests the assumption that (1) exposure is stable; or (2) pathogenic effects are long-lasting or delayed and unaffected by subsequent exposure developments.

Information from multiple time points may help clarify possible differences in the course of exposure for individuals experiencing similar exposure at baseline. Furthermore, repeated measurement aids the reliable classification of “chronic” exposure. The current study addressed such concerns by applying a group-based trajectory model [31] to identify groups of employees exhibiting different time-courses of exposure.

## 2. Methods

### 2.1. Design and participants

Data were gathered by an ongoing research project entitled “The new workplace: Work, health, and participation in the new work life”, a web-based survey carried out by the National Institute of Occupational Health in Norway. The current study analyzed follow-up data (3 waves) for employees who were previously included in a larger 2-wave study elucidating psychological and social work factors as predictors of musculoskeletal pain [4]. The eligible study population consisted of all employees in companies that conducted this work environment survey. Most participants were permanent employees (97.5%) in full-time employment (90%) who worked regular hours during daytime (84%). Eighteen percent had managerial responsibilities.

After comprehensive information about the general study aims had been disseminated at the company level, all employees received a letter containing a personal access code to log in to the web-based questionnaire. Informed consent was obtained at the beginning of the questionnaire. Data were gathered with permission from the Norwegian Data Inspectorate and strict procedures were maintained to ensure confidentiality. These reassurances were communicated to participants to motivate response and avoid biased responses due to fear of sensitive information being revealed. The survey comprised a comprehensive set of items intended to fulfill manifold research aims. For the companies, the main aim was to monitor and improve working conditions. Items pertaining to the research questions of the current study received no particular focus in the comprehensive survey. Further information about the recruitment procedure and the survey content has been published elsewhere [4].

The current study analyzed data gathered over 3 measurement occasions, each 2 years apart, in 13 Norwegian companies (7 public and 6 private). The first measurement occasion spanned from May

2005 to February 2008 for different companies, the second from May 2007 to March 2010, and the third from May 2009 to March 2012. For practical reasons not all companies were able to adhere strictly to the desired length of the follow-up period, so slight variations occurred. The average lengths of the first and second follow-up periods were thus 23.9 and 22.6 months, respectively.

The questionnaire was distributed 3 times to a total of 1560 employees. Response at each time point (T1, T2, and T3) was defined as the completion of at least one item relevant to the current study. Thus, response rates at T1, T2, and T3 were 89.9%, 72.5%, and 64.0%, respectively. Furthermore, subjects had to respond on at least 2 measurement occasions to be included in the analyses. Thus, data from 80.3% (1250 of 1560) of invited employees were analyzed. Out of these, 1196 (95.7%) responded at T1, 1109 (88.7%) at T2, and 973 (77.8%) at T3. Missing values comprised 13.4% of potential values. Furthermore, most respondents completed most items, with an average of 8 out of 59 items missing per participant.

### 2.2. Outcome measures

The aim of the current study was to estimate the course of exposure over 4 years to evaluate the effect on the prevalence of neck pain. Thus, the outcome was the presence of neck pain at the final measurement occasion—after exposure was incurred. This definition encompasses all neck pain and is not confined to severe pain or pain that interferes with function, work ability, or performance. Although studying the impact of pain on such aspects of employees’ lives is of crucial importance, the focus of the current study was on studying factors that may contribute to pain itself. Information was derived from the reported intensity of neck pain during the 4 weeks prior to completing the questionnaire. This item was part of a somatic symptom checklist comprising 21 different health complaints [41]. The item wording was “have you been troubled by neck pain the last 4 weeks”, with response categories: 1 = Not troubled; 2 = A little troubled; 3 = Rather intensely troubled; and 4 = Very intensely troubled. Thus, subjects reporting categories 2–4 were classified as reporting pain. The wording “troubled by” is a common way of expressing somatic symptoms in the Norwegian language.

### 2.3. Exposure measures

Psychological and social factors were assessed with the General Nordic Questionnaire for Psychological and Social Factors at Work (QPS<sub>Nordic</sub>) [6], an instrument developed to facilitate both research and practical work environment improvement [6,45].

Previous research has mainly examined *job demands* (encompassing role conflict, time pressure, and work amount), *decision latitude*, and *supervisory support*, as well as specific combinations of these factors (ie, high demands with low decision latitude and lack of support). One aim of the current study was to elucidate some of these “traditional” factors as well as some that have been less studied. An additional aim was to elucidate the implications of studying exposure over extended time periods with repeated measurements, as opposed to more common 2-wave studies of period-specific exposure. Assessments of exposure over extended periods of time that take into account variations throughout the period may provide detail to enhance the understanding of the impact of exposures on health. Therefore, we wished to study some factors that we previously found to be predictive, as well as some factors that we had found *not* to be predictive of neck pain intensity, in order to judge whether the role of these factors would change when more comprehensive analyses were conducted. Thus, previously supported predictors of pain that were included in the current study were *role conflict* (3 items, eg, “do you receive conflicting requests

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