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Office workers' computer use patterns are associated with workplace stressors

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ABSTRACT

This field study examined associations between workplace stressors and office workers' computer use patterns. We collected keyboard and mouse activities of 93 office workers (68F, 25M) for approximately two work weeks. Linear regression analyses examined the associations between self-reported effort, reward, overcommitment, and perceived stress and software-recorded computer use duration, number of short and long computer breaks, and pace of input device usage. Daily duration of computer use was, on average, 30 min longer for workers with high compared to low levels of overcommitment and perceived stress. The number of short computer breaks (30 s–5 min long) was approximately 20% lower for those with high compared to low effort and for those with low compared to high reward. These outcomes support the hypothesis that office workers' computer use patterns vary across individuals with different levels of workplace stressors.

1. Introduction

Work-related neck and upper extremity pain constitutes a considerable burden among computer workers with 2-year follow-up prevalence rates of 31, 33, and 21% for neck, shoulder, and forearm/hand symptoms, respectively (Eltayeb et al., 2009). In addition to serious physical consequences for the individuals involved, neck and upper extremity pain results in high costs for society due to productivity loss and sick leave (Hagberg et al., 2007; Van den Heuvel et al., 2007a).

There are numerous observational studies suggesting that neck and upper extremity pain in computer workers can result from workplace stressors. This may be due to an increased physical load observed during exposure to these stressors (Wahlstrom, 2005; NRC/IOM NRCaloM, 2001; Sauter and Swanson, 1996). Workplace stressors include high perceived stress, high work demands (e.g. task difficulty and time pressure), little control at work, low social/work support from colleagues or supervisor, low task variation, high overcommitment, high efforts, and low reward (Bongers et al., 2006; Eltayeb et al., 2009; Huysmans et al., 2012; McLean et al., 2010; Norman et al., 2008; Siegrist et al., 2004). In office workers, effort, reward, overcommitment, and perceived stress were shown to be the workplace stressors most consistently related to neck and upper extremity pain (Bongers et al., 2006; Huysmans et al., 2012; Van den Heuvel et al., 2007b). A higher physical load may include increased muscle activity, more awkward postures, higher keyboard and mouse forces, and high repetition of movements (Eijckelhof et al., 2013a; Ekberg et al., 1995; Nordander et al., 2013;

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Punnett and Wegman, 2004; Wahlstrom, 2005; Sauter and Swanson, 1996; Jensen, 2003).

It is possible that high levels of workplace stressors increase workers' physical load directly through increased general arousal (Bruno Garza et al., 2013; Eijckelhof et al., 2013b). Another option is that with high levels of workplace stress, workers change their individual patterns of exposure (i.e. in terms of duration, frequency, and duty cycle (Potvin, 2012)), as suggested by Bongers et al. (2006). Specifically, three possibilities have been proposed. First, workers with high levels of workplace stressors may spend more time working at their computer (Andersen et al., 2008; Chang et al., 2007; IJmker et al., 2007, 2011). Second, a combination of the number and duration of periods without computer use throughout a workday may be of importance. Workers with high levels of workplace stressors may reduce their computer break periods, increasing the risk of developing acute discomfort or long-term neck and upper extremity pain (Sharan et al., 2011; Henning et al., 1997; Huysmans et al., 2012; McLean et al., 2001; Menendez et al., 2008; Norman et al., 2008; Van den Heuvel et al., 2003). A third possibility is that in addition to computer duration and computer break patterns, workers with high levels of workplace stressors (such as overcommitment) increase the pace of input device usage (Eijckelhof et al., 2013a,b), which could increase the risk of developing neck and upper extremity pain (Nordander et al., 2013).

Previous studies have indicated that individual exposure patterns including computer duration, computer break patterns, and the pace of input device usage may result from increased exposure to stressors. Johnston et al. (2010) demonstrated that workers' responses to supervisor support, decision authority, and skill discretion influenced their exposure as measured through time spent on computer work and mouse use duration. Also, Van den Heuvel et al. (2007b) found that in response to high overcommitment, office workers took fewer computer breaks and had higher self-imposed workload. However, these reports on the relation of job demands and individual exposure patterns, including computer duration and computer break patterns, are based on self-reported computer use data and might differ from directly measured computer duration and break patterns (Barrero et al., 2009; IJmker et al., 2011). When both methods are compared, direct measurements of computer use have been shown to have the highest test–retest reliability (IJmker et al., 2008).

To date, information on the relation between workplace stressors and directly measured patterns of exposure among office workers is scarce and mostly limited to self-reported measures of work patterns or laboratory-based studies. Therefore, in an actual workplace setting using computer interaction monitoring software, this study aimed to examine whether workplace stressors affected directly measured computer work patterns including: the time spent working at the computer, the number and duration of computer breaks, and the pace of input device usage including key strike frequency, the duration of individual key strikes, mouse movement speed and mouse button clicking frequency. We would like to note that the term “computer break”, which we use throughout this paper, refers to a period without computer interaction and not necessarily a period of rest.

The aim of our study is to answer the following research question: “Do high levels of workplace stress lead to adverse computer use patterns (i.e. total computer duration, computer break patterns, and the pace of input device usage)?”

We chose to focus on four workplace stressors thought to be risk factors for developing neck and upper extremity pain: 1) effort, 2) reward, 3) overcommitment, and 4) perceived stress (Cohen et al., 1983; Siegrist et al., 2004). The first two stressors represent organizational factors and the latter two represent individual responses to environmental factors.

We hypothesize that high compared to low levels of effort, overcommitment, and perceived stress and low compared to high levels of reward are associated with:

- Longer duration of computer use (more exposure),
- Smaller 8-h frequency of computer breaks (short and long computer breaks);
- Higher pace of work as measured through high key strike frequency, shorter key strike duration, higher mouse movement speed, higher mouse button clicking frequency.

2. Methods

2.1. Experimental design and participants

This study used the data set from the PROOF study (PRedicting Occupational biomechanics in OFfice workers), which had the overall aim to investigate the effects of workplace stressors on biomechanical loading during computer use in office workers in actual field settings. Participants were recruited from 8 departments at the VU University and 1 department at the VU University Medical Center in Amsterdam, The Netherlands (Bruno Garza et al., 2012). One-hundred-twenty workers were recruited for the PROOF study, and to be eligible, their main work tasks had to involve working with the computer (to capture differences which are more likely to result from work-related stress rather than from job content), working at least 20 h per week (to reduce workload differences across the subjects), and being free of musculoskeletal symptoms one week prior to participating in the study (to avoid influence of pain).

All protocols and consent forms were approved by the Harvard School of Public Health Human Subjects Committee, the Medical Ethics Committee of the VU University Medical Center Amsterdam, and the Ethics Committee of the Faculty of Human Movement Sciences of VU University Amsterdam.

2.2. Data collection and data processing

2.2.1. Computer interaction

We installed Computer interaction monitoring (CIM) software, which was a Labview based application, onto the participants' computers. The CIM software ran in the background of the participants' computer for a minimum of one week and automatically recorded the time and duration of each key strike (without the key identified) and each mouse event (cursor movement duration and distance in pixels, scrolling, mouse button activity).

With these event data we calculated periods with and without computer activity, thereby capturing a worker's individual computer use patterns. Computer activity included i) keyboard activities, ii) mouse activities, and iii) idle activities. Keyboard activity was defined as a series of keyboard events (key strikes) that had less than 2 s of inactivity between successive keyboard events. Mouse activity was defined as a series of mouse events (mouse movement, scrolling, or button clicks) that had less than 2 s of inactivity between successive mouse events. Finally, idle activities were defined as any period of keyboard or mouse inactivity that lasted at least 2 s but less than 30 s (Dennerlein and Johnson, 2006; Hwang et al., 2010; Yeh et al., 2009). Idle activities include passive computer-related activities such as viewing the screen. Periods with non-computer activities were defined as any period without computer activity greater than 30 s (Blangsted et al., 2004; Chang et al., 2008) and could represent a rest break or work-related non-computer activity.