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Inter- and intra- observer reliability of risk assessment of repetitive work without an explicit method

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ABSTRACT

A common way to conduct practical risk assessments is to observe a job and report the observed long term risks for musculoskeletal disorders. The aim of this study was to evaluate the inter- and intra-observer reliability of ergonomists' risk assessments without the support of an explicit risk assessment method. Twenty-one experienced ergonomists assessed the risk level (low, moderate, high risk) of eight upper body regions, as well as the global risk of 10 video recorded work tasks. Intra-observer reliability was assessed by having nine of the ergonomists repeat the procedure at least three weeks after the first assessment. The ergonomists made their risk assessment based on his/her experience and knowledge. The statistical parameters of reliability included agreement in %, kappa, linearly weighted kappa, intraclass correlation and Kendall's coefficient of concordance. The average inter-observer agreement of the global risk was 53% and the corresponding weighted kappa (K_w) was 0.32, indicating fair reliability. The intra-observer agreement was 61% and 0.41 (K_w). This study indicates that risk assessments of the upper body, without the use of an explicit observational method, have non-acceptable reliability. It is therefore recommended to use systematic risk assessment methods to a higher degree.

1. Introduction

Deficiencies in the work environment contribute to the development of musculoskeletal disorders (MSDs), which can have economic consequences for the individual, society and employers. Work-related exposures such as repetitive work, forceful exertions, awkward postures, and vibration, as well as psychosocial and organisational factors are related to the development of MSD (Bongers et al., 2006; Bovenzi, 2006; Lang et al., 2012; Palmer and Smedley, 2007; Punnett and Wegman, 2004; Putz-Anderson et al., 1997; van Rijn et al., 2009a, b; 2010). According to safety and health legislation and recommendations, regular risk assessments should be carried out to identify and prevent potentially harmful work tasks (European Council, 1989). Risk assessment is also an important tool when planning and prioritising work environment interventions such as changes in the physical design of the workplace, in work technique or in work organisation. Sometimes these interventions can lead to an extensive investment for the employer. After interventions, new risk assessments may be carried out for evaluation purposes. Furthermore, work environment authorities also uses risk assessments when legislative measures are taken towards an employer. It is therefore highly important that risk assessments are valid and reliable.

Ergonomists employed in occupational health services (OHS) often perform risk assessments of physical work environments. Observational methods are described as useful for identifying and assessing potentially harmful occupational exposures due to their low cost and ability to present the result in a way that is easy to understand (e.g. in different risk levels). Several observational methods have been developed for the identification and quantification of physical exposures at work (Dempsey et al., 2005; Neumann, 2007; Takala et al., 2010). Inter-observer reliability studies of different observational methods show mixed results and comparisons between the studies are hampered by differences in the choice of statistical methods. (David et al., 2008; Comper et al., 2012; Spielholz et al., 2008; Stevens et al., 2004; Paulsen et al., 2015).

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Very few observational methods have been evaluated with regards to their predictive validity, i.e. do more adverse risk scores predict increased incidence of MSD (Takala et al., 2010). Nevertheless, most observation methods purport to include the dimensions of amplitude, frequency and duration of harmful exposure, and assume that the higher combined score, the higher the risk of MSD.

Different observational methods assess different types of exposure (manual handling, repetitive work etc.) and the selection or combination of methods should be based on the need of the assessment and the exposure type (Takala et al., 2010). In several observational methods different exposure parameters are observed and rated, and then those parameters are used to calculate a total score which is then converted to different risk levels, *e.g.* green, yellow or red.

As for usage, a web-survey among Swedish ergonomists in 2012 revealed that knowledge about and use of different risk assessment methods was relatively low (Eliasson et al., unpublished manuscript). The study further indicated that ergonomists often assess risks in the work environment solely by means of observation, based on his/her knowledge and experience, without the use of any systematic methodology or explicit method. The results of that study are in agreement with other studies (Wells et al., 2013; Whysall et al., 2004). Furthermore, Whysall et al. (2004) reported that evaluation of implemented recommendations is rare. When risk assessments are reported back to the client is it often in the manner of risk levels defined by a "traffic light" scale, where red = high risk/immediate action is needed; yellow = medium risk/investigate further; or green = low risk/acceptable exposure, which are the levels proposed in the Ergonomic Provisions from the SWEA (Hägg, 2003; Koningsveld et al., 2005; Lind and Rose, 2016; SWEA, 2012). However, in contrast to when systematic observational methods are used, these risk levels are empirically derived, and not based on a calculated score from ratings of different exposure parameters.

One important risk factor for MSD, especially in the neck and upper extremities, is exposure to repetitive work (Nordander et al., 2013; Palmer et al., 2007; Palmer and Smedley, 2007; van Rijn et al., 2009a, b; 2010). However, movements occurring in repetitive work, for example movement velocity, are more difficult to assess using observation compared to assessments of exposures that include macro-postures (Ketola et al., 2001; Lowe, 2004; Spielholz et al., 2001; Takala et al., 2010). Consequently, seeing that risk assessments of repetitive work can be difficult to perform and that assessments are often made without the use of an explicit method, it is of interest to analyse how ergonomists' own "expert" assessments of repetitive work conform between different ergonomists and different assessment occasions.

The overall aim of the present study was to investigate the inter-observer and intra-observer reliability of risk assessments performed by ergonomists without the use of an explicit observational method.

2. Method

2.1. Observers

In total, 21 OHS-ergonomists participated as observers in the present study. They were recruited through contact with different OHS companies and through social media posts to members of the Swedish Ergonomist and Human Factors Society (EHSS). Employment at an OHS (or equivalent) and at least one year of work experience in the sector, including experience with risk assessments, were the necessary requirements for observer participation in the study. Details about the observers are presented in Table 1.

2.2. Video recorded work tasks

Ten different work tasks from various job sectors were selected (i.e. grocery store shop assistant, meat cutting, industrial assembly, cleaning, post sorting and hairdressing; Table 2). The work postures and movements were mainly of a repetitive character.

Each work task was recorded using two to four video cameras from different angles to enable the best possible conditions for the risk assessments. For each work task, the different views were synchronised into one video with multiple frames to show the different views of the worker with a close-up on hand and wrist movements. Each of the finalised video recordings was two to six minutes long.

2.3. Procedure

In the beginning of the first meeting, a 25-min introductory lecture was given. The lecture included general information regarding procedures for performing risk assessments. Special emphasis was put on the quantification of work task exposure in the dimensions of intensity, frequency and duration of work task. The lecture also addressed the increased demands made by the Swedish Work Environment Authority (SWEA) concerning ergonomic risk assessments (SWEA, 2012), where a paragraph (§4) in the present Ergonomic provisions has been added in comparison to

Table 1
Characteristics of the observers (n = 21).

Observer characteristics		
Age, mean (range)		51 (40–64)
Women, n (%)		20 (95)
Years of work experience within physical ergonomics, mean (range)		14 (4–26)
Client Company Sectors, n (%)	Industry	16 (76)
	Office	15 (71)
	Service and Trade	4 (19)
	Healthcare	7 (33)
	Other[a]	3 (14)
Frequency of risk assessment assignments, n (%)	Once a week	4 (19)
	Once a month	8 (38)
	Once every three months	5 (23)
	Once every six months	1 (5)
	Once a year	2 (10)
	Less than once a year	1 (5)

[a] Other sectors; e.g. the Swedish Armed Forces and different municipal sectors.