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The role of assessment of biomechanical exposure at the workplace in the prevention of musculoskeletal disorders

Musculoskeletal disorders constitute an important part of the work-related burden of disease (1). Various components of biomechanical exposure at the workplace play a prominent role in the onset and aggravation of musculoskeletal disorders. Recent publications in the *Scandinavian Journal of Work, Environment & Health* have addressed physical risk factors for specific musculoskeletal disorders (2, 3), and subsequent consequences for productivity loss at work (4, 5), sickness absence (6), and disability (7). Despite this knowledge, however, it is still difficult to quantify the exact levels of biomechanical exposure at which an increase in the occurrence of musculoskeletal disorders occurs. This has hampered our ability to recommend acceptable levels of biomechanical exposure at work (8), whereas for chemical agents many threshold limit values are available that guide the occupational health professional in the prevention of work-related diseases. Primary preventive interventions to reduce biomechanical exposure at work have difficulties in demonstrating that a reduction in biomechanical exposure results in a lower occurrence of musculoskeletal disorders (9, 10). The assessment of biomechanical exposure has emerged as a key issue in developing guidelines to prevent the onset of musculoskeletal disorders in occupational populations and designing appropriate primary preventive interventions that reduce hazardous biomechanical exposure to levels that no longer harm the workforce.

The most widely used method of assessing physical load during work is still the self-administered questionnaire, mainly because data collection costs are low, application is feasible in every study design, a large array of different parameters of exposure can be determined simultaneously, and all risk factors are assessed with a similar approach (11). However, the validity of self-reported biomechanical exposure is low and most measures of exposure lack sufficient precision and accuracy to present valid estimates of the mean level of biomechanical exposure in occupational groups. Hence, the exposure information is too crude to derive exposure guidelines or evaluate the success of preventive interventions. At best, well-designed questionnaires are able to identify relative differences in exposure among occupational groups and, hence, rank these groups according to their overall level of biomechanical exposure at work.

In recent years several observational methods have been developed to assess biomechanical exposure at the workplace. In this issue of the *Scandinavian Journal of Work, Environment & Health*, Takala and colleagues present a systematic evaluation of these observational methods (12). A total of 30 observational methods were identified that evaluate biomechanical hazards at work, monitor the effects of ergonomic improvements, and enable research on exposure–response relationships. These methods are capable of simultaneously assessing different awkward postures, strenuous movements, and manual materials handling in various work situations. The comprehensive evaluation showed that 19 out of 30 observational methods had moderate-to-good agreement with direct measurements from video recordings. Agreement was better for large-scale body postures and work actions, such as trunk flexion, squatting, kneeling, and lifting activities. Micropostures like wrist and hand movements as well as neck and trunk rotation were more difficult to assess with reasonably accuracy. In observational methods, a lack of precision may arise from intra- and inter-observer variance, but overall repeatability, when evaluated, was moderate to good.

An interesting conclusion of the review was that very few publications on observational methods present any insight into the appropriate exposure assessment strategy. The choice for a particular observational method not only depends on its validity and repeatability, but also on its feasibility to describe exposure patterns in the study population with sufficient detail on frequency, duration, and magnitude of relevant parameters of exposure, taking into account the variation in exposure within and between workers

and across determinants of biomechanical exposure. In any study, crucial decisions must be made about how to allocate best the measurement efforts across individual workers, work situations, and work days, taking into account the performance of the observational method chosen, the required discriminatory power, and variation in parameters of biomechanical exposure. In intervention studies, these decisions will determine whether the application of an observational method will be able to demonstrate a significant impact of an ergonomic improvement. Commonly adopted strategies often fail to detect an intervention's effect on the overall biomechanical exposure in some jobs due to the fact that too few measurements have been collected. It has been shown that, even for large differences in biomechanical exposure, a substantial number of measurements is required (13) and that limited exposure sampling may result in a low probability of detecting any intervention effect at all (14).

The importance of Takala et al's review is the guidance it offers to researchers and occupational health professionals in selecting the best method in relation to the study to be conducted. The authors' recommendations provide good advice on the initial selection of the most appropriate observational method for biomechanical exposure and design of the sampling strategy in order to provide productive results. There is a clear need for better quantification of biomechanical exposure at work and observational methods may play an important role in this endeavor. Researchers and professionals are challenged to adopt these methods to design and implement appropriate primary preventive interventions on hazardous biomechanical exposure in order to reduce the high burden of disease due to work-related musculoskeletal disorders.

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