

FURTHER DEVELOPMENT OF THE QUICK EXPOSURE CHECK (QEC)

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The Quick Exposure Check (QEC) was developed to enable health and safety practitioners to undertake assessments of the exposure of workers to musculoskeletal risk factors (Li and Buckle, 1998). QEC focuses on exposure assessment and change in exposure, thus allowing benefits of workplace interventions to be assessed rapidly. The development of the tool involved a novel participatory approach and had input from approximately 160 health and safety practitioners. The method has been published and is freely available in electronic form. Further research and development to improve the scope, usability and validity of QEC has been carried out. Four facets of usability were investigated: attitude; learnability, training and support; flexibility; and effectiveness (Shackel, 1991). Experienced users were interviewed to identify the strengths and weaknesses of the assessment tool. A focus group was also conducted to determine the experiences of ergonomists in the use of QEC. These data provided the basis for an improved version of QEC. Modifications were also made to the QEC forms and guidance material, in accordance with good practice on the presentation of graphic information. The improved versions of the tool have been tested by practitioners and the reliability and validity evaluated with practitioners and experts in the workplace. Revisions based on these trials have provided an improved QEC and a support package.

ASSESSMENT TECHNIQUES FOR EXPOSURE TO WORK-RELATED MUSCULOSKELETAL DISORDERS RISKS

Various methods have been developed for assessing exposure to musculoskeletal disorders risk factors (Li and Buckle 1999). The majority are posture-based techniques that concentrate on the back neck shoulder and arms. Most have been used in studies that have investigated the relationship between occupational risk factors and musculoskeletal disorders of the upper body regions, and have not investigated the lower limbs.

The choice between the range of methods available will depend upon the application concerned and the objectives of the study, but clearly there is a need for assessment methods that can be applied effectively by non-specialist practitioners who may have limited time and resources to conduct assessments in the workplace.

REQUIREMENTS FOR ASSESSMENT TECHNIQUES FOR PRACTITIONERS

The assessment of exposure to musculoskeletal disorders risk factors is a vital part of the management and prevention of work-related musculoskeletal disorders (WMSDs). Exposure assessment relies on the acceptance of established “risk factors” for a number of

musculoskeletal disorders, based on current “state of the art” research findings. This assessment should lead to consideration of the changes to workstations, tools, equipment and working methods that are possible to eliminate or at least minimise the levels of exposure. Following the change, exposure should be re-assessed to confirm the efficacy of the intervention. This can be done immediately following the change, in contrast to using outcome measures such as reported injuries or sickness absence as evaluation criteria, when a time lag of many months between the change and any measurable affect may occur. In contrast, risk assessment requires that the magnitude of the outcome of interest, such as reported injuries or sickness absence levels, for a given exposure be estimated for the population of interest (National Research Council 1983).

Ideally, therefore practitioners need techniques to assess exposure that -

- are easy and quick to use, requiring limited data collection,
- are sufficiently flexible to be used across a range of jobs,
- are comprehensive and reliable for a range of risk factors (not solely posture),

- will identify if an intervention is necessary, and then following the intervention
- will register whether it is effective.

DEVELOPMENT OF QEC

One tool that has been designed specifically to meet the requirements of practitioners is the Quick Exposure Check [QEC]. It was developed at the Robens Centre for Health Ergonomics (Li and Buckle 1998), largely by using a participatory ergonomics approach, with some 160 practitioners being involved at different stages of the process.

QEC has been designed to

- assess the change in exposure to musculoskeletal risk factors before and after an ergonomics intervention,
- involve both the practitioner (observer) and the workers (who have direct experience of performing the job) in conducting the assessment and identifying the possibilities for change,
- encourage the improvement of workplaces and allow consideration of the comparative impact and potential cost benefits of a number of alternative interventions,
- educate managers, engineers, designers, health and safety practitioners and other end users about the musculoskeletal risk factors in the workplace,
- compare exposures between two or more workers performing the same task, or between people performing different tasks,
- focus on exposure assessment and change in exposure, thus allowing benefits of workplace interventions to be assessed rapidly.

QEC includes the assessment of the back, shoulder/upper arm, wrist/hand, and neck, with respect to their posture and repetitive movement. Information about task duration, maximum weight handled, hand force exertion, exposure to vibration, the visual demands of the task and subjective responses to the work is obtained from the worker.

The magnitude of each assessment item is classified into exposure levels, and combined exposures between different 'risk factors' are calculated by using a score table. Thus, the QEC Exposure Scores are based on combinations of risk factors identified by the observer and the worker for each body part and for the worker's subjective responses. Higher scores result from the combination of two higher-level exposures between

different risk factors than to the combination of two lower-level exposures.

These scores represent a hypothetical relationship between the increased level of exposure and the potential health outcomes. Current epidemiological evidence is not sufficient to define the actual relationship for different working situations. Nevertheless, the existing scoring system provides a basis for comparing the effects of changes before and after an intervention.

QEC was developed, tested, modified and validated based upon both simulated and real work tasks. The tasks covered a wide range of work activities, such as manual material handling, repetitive tasks, static or dynamic tasks, seated or standing tasks, and tasks with low or high visual demands. Studies demonstrated that QEC had good sensitivity and usability, 'acceptable' or 'moderate levels of agreement' for its inter-observer reliability, and a good intra-observer reliability. Field studies have indicated that it is reliable in a practical context and suitable for a wide range of jobs. Following a brief training period (self-learning), assessments can normally be completed within about ten minutes for each task.

FURTHER DEVELOPMENT OF QEC

In the past three years, QEC has been used effectively by many health and safety practitioners to undertake workplace assessments. Nevertheless, the need has been identified for further research and development to improve its scope of use, usability and validity.

This research has aimed to:

1. review the experiences of current users and experts
2. refine and improve the tool
3. re-assess QEC's usability
4. investigate its inter-user reliability
5. undertake validation studies in the workplace
6. provide a revised QEC incorporating an improved scoring method, together with a support package for end users.

The feedback from both experienced and first time users identified the need for improvements to:

- the scope of the guidance
- the layout of the forms
- the terminology for the workers questions and responses
- the transparency of the scoring system

This has resulted in

- the provision of improved guidance on:
 - setting priorities for assessment and how to divide a job into tasks that can be assessed separately
 - ensuring that the assessment is based upon a representative sample of the work and workforce doing the job
 - informing workers about what is being done and gaining their co-operation
 - completing the assessment form and explanations of the exposure categories
 - and in due course, advice on making improvements and the provision of case-study examples
- a one-page assessment sheet with
 - re-worded and reformatted questions for both the practitioner (observer) and the worker
 - a dedicated space for comments to be recorded
- improvement to the format of the scoring sheet, that increases transparency and identifies where exposures are highest, and consequently, where intervention measures will have greatest effect.

The usability of the new versions of the forms and guidance have been evaluated by practitioners using simulated tasks. They completed the assessment of a single repetitive task within a ten-minute period and successfully determined the corresponding exposure score. The single page format has been endorsed, and additional feedback used to make further design refinements.

Trials were undertaken to assess the reliability of QEC between practitioners when evaluating the same tasks and workers. Six subjects did QEC assessments on three simulated tasks that represent different types of work i.e.

- routine DSE keyboard work,
- light physical work (pipetting), and
- heavy physical work (floor cleaning).

Each subject assessed each task independently. Inter-reliability scores were calculated based on the findings.

The redesigned forms and guidance have been validated in the workplace to ensure that accurate exposure assessments are made across a range of tasks and working environments. Five organisations from different industrial sectors took part in this phase of the study. A range of tasks were assessed at each organisation by both a practitioner from the organisation and by an expert from the study team. The tasks selected covered a wide range of potential

workplace exposures and allowed the new version to be evaluated. In addition, digital video recordings of the work tasks were made and other variables identified. The video was analysed subsequently by the study team to confirm the data gathered in the workplace. The responses of both the practitioner and worker to the QEC assessment were recorded during a short interview.

CONCLUSIONS

Over the past twenty years the assessment of musculoskeletal disorders has become an increasingly high priority for many organisations and a wide range of techniques have been developed dependent upon the application concerned. All of these techniques have advantages and disadvantages: some have been found to be more suited to research investigations whereas others have been used by Occupational Safety and Health practitioners in the workplace to identify where changes are necessary.

The assessment (WMSD), however, is still a challenging area. This is because the underlying mechanisms that result in these conditions are not clearly understood, and doubt remains about the varying contribution of a range of risk factors (nature and critical levels) and their interactions in precipitating a reported injury. Further research is necessary that will allow cause and effect to be defined more precisely. The establishment of the relationship between exposure and affect is not an easy task however, as a recently reported evaluation of the revised NIOSH lifting equations has shown (Dempsey, 2002). The range of manual materials handling jobs that could be analysed was restricted and it proved difficult to find jobs where exposure was constant over the day as opposed to a complex combination of factors resulting from the performance of a varying range of tasks.

In the absence of the above information, and in light of the substantial interest in the identification and control of risk factors for WMSDs, an alternative, interim approach is to consider the exposure variables that can be observed and the change that occurs as a result of an ergonomics intervention. This approach relies on the agreement of established risk factors for a number of WMSDs based upon current research knowledge (NIOSH, 1997, National Research Council, 1999). Assessment of the changes in exposure following an intervention provides an alternative and rapid measure of the effectiveness of the change.

User participation in the design of assessment techniques will ensure that they are practical to apply in the workplace and that they provide the basis for making changes to prevent or reduce WMSDs.

REFERENCES

- Dempsey, P G 2002. Usability of the revised NIOSH lifting equation, *Ergonomics* 45 (12) 817-828
- Li, G. and Buckle, P. 1998. The development of a practical method for the exposure assessment of risks to work-related musculoskeletal disorders. HSE Books. Suffolk
(<http://www.hse.gov.uk/research/content/crr/1999/crr99251.htm>)
[Accessed 27 January, 2003]
- Li, G. and Buckle, P. 1999. Current techniques for assessing physical exposure to work-related musculoskeletal risks, with emphasis on posture-based methods. *Ergonomics* 42, 5674-695
- National Research Council, 1983. Risk assessment in the federal government: managing the process. Washington, DC. National Academy Press
- National Research Council, 1999. Work-related Musculoskeletal Disorders: Report, Workshop Summary, and Workshop Papers. National Research Council. National Academy Press, Washington.
- NIOSH, 1997. Musculoskeletal disorders and workplace factors: a critical review of the epidemiological evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back. NIOSH Publication N0 97-141, DHHS, Cincinnati
- Shackel, B 1991. Usability – context, framework, definition, design and evaluation. In Shackel, B and Richardson, S (Eds) *Human Factors for informatics Usability*. Cambridge University Press 21-38