Pre-employment functional assessments as an effective tool for controlling work-related musculoskeletal disorders: a review

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ABSTRACT

Work-related musculoskeletal disorders have substantial direct and indirect costs to both employers and employees. It is in the best interest of both parties to implement workplace programs that reduce these costs. Pre-employment functional assessments (PEFAs) are a tool that may assist in reducing the severity and costs of work-related musculoskeletal disorders.

As with all work-related assessments, pre-employment functional assessments must meet five basic criteria: safety, reliability, validity, practicality and utility. The criteria of validity and utility are the focus of this review. When assessing the effectiveness of pre-employment functional assessments, the tester is advised to differentiate between issues of an individual's safe working capacity and a prediction or speculation about possible injury.

An employee is considered physically capable of performing a task when their capabilities meet or exceed the key physical requirements of a job. Traditional methods of assessing a worker's suitability for a task such as medical screening and isometric strength testing have been proven ineffective in making this judgement. Valid pre-employment assessments are based on functional tasks including fitness assessments and safe manual handling ability. The rationale for inclusion of various tests in a pre-employment functional assessment is discussed.

Pre-employment functional assessments meet the needs of the employee by providing a safe and objective assessment of their current physical capabilities. They meet the needs of the employer by identifying the matches between workers and their tasks in a non-discriminatory way to reduce the severity and costs of work-related musculoskeletal injuries.

The need for further research into the effectiveness of pre-employment functional assessments as an effective tool for controlling work-related musculoskeletal disorders is identified.

Relevance to Industry

It is important to employers that when investing resources in the management of work-related musculoskeletal disorders that these resources are allocated to activities which have been shown to be appropriate for meeting their needs.

INTRODUCTION

Work-related musculoskeletal disorders cost companies millions of dollars every year in the form of reduced productivity, replacement wages, medical costs, lump sum payments and performance-based workers compensation premiums. There were a reported 64,172 work-related sprains and strains costing Queensland employers an average of $ 4,463 per claim according to QComp (Queensland's workers compensation scheme regulator) statistics for 2000/01 alone. Of these, 47.4% were back-related injuries. The Queensland Workplace Health and Safety Act 1995 Section 28 (1) states "An employer has an obligation to ensure the workplace health and safety of each of the employer's workers at work" and all other Australian jurisdictions have similar requirements. For manual tasks, this is typically achieved by modifying tasks and equipment in an effort to match the task to the human. Sometimes, as a result of technical or cost considerations, this approach becomes impractical and the shift then changes to matching the worker to the task. In these circumstances there have been a number of strategies employed to determine or attempt to minimise a worker's future risk of injury, including back Xrays, manual handling training, history of previous pain and medical screenings such as strength and endurance and body composition testing. To date there is limited evidence of their success (Bigos & Battié, 1987; Reimer et al, 1994; Snook, 1987).

A more recent approach in employee assessment has been the use of pre-employment or post-offer functional assessments with the majority centred around the format of Functional Capacity Evaluations. A Pre-Employment Functional Assessment (PEFA) is a series of tests that provide objective information about a worker's functional capabilities in relation to the job for which they are applying. Innes and Straker (2003) used the National Institute for Occupational Safety and Health (NIOSH) criteria for the development and selection of work-related assessments, in order to summarise the key attributes of an assessment as being: safety, reliability, validity, practicality and utility (Table 1). Whilst safety is obviously the primary aim of any assessment, this paper focuses on the issues of validity and utility of functional assessments in a pre-employment context.

Safety	Is the test safe to administer?
Reliability	Are the test results reproducible on any occasion between evaluators (inter-rater) and participants (test-retest)?
Validity	Does the test measure what it reports to measure and is it predictive of performance?
Practicality	Is the test easy to administer with reasonable / minimal cost?
Utility	Does the functional test relate to job performance and does it meet the needs of the involved parties?

Table 1: Key Attributes of Work-Related Assessments
Based on Randolph (2000), Innes & Straker (2003), King et al (1998)

A key distinction needs to be made when evaluating the effectiveness of pre-employment functional assessments (PEFAs) in controlling work-related musculoskeletal disorders. That distinction relates to whether or not the assessment is being used to assess an individual's current safe working capacity or as a predictor of injury. Anderson (1999) believes that the emphasis of a PEFA should be on objective information such as an individual's ability to perform the job rather than speculative conclusions such as risk of injury that may occur in the future. This approach is also consistent with current anti-discrimination legislation. Whilst it may seem that these are essentially the same thing, a review of the literature indicates a need for them to be treated as two separate issues to obtain accurate data on their effectiveness. The writer believes that much of the confusion in the literature and thus for consumers of these products occurs because these two issues are not clearly delineated. Another reason for the inconclusiveness of the available literature on the effectiveness of these tools is that in the vast majority of cases the focus of these studies attention has been concentrated on back injuries and back function to the exclusion of the rest of the body which accounts for just over half of the remaining work-related musculoskeletal disorders.

Validity

An assessment task will be considered valid if the result can be equated to the job being evaluated (Randolph, 2000). To be able to make this comparison, first a comprehensive job analysis needs to be undertaken to determine the key physical requirements of each task and should include the weights, forces, frequency and duration (Scott, 2002). From this information a PEFA tailored to the job for which the applicant is applying can be developed. The results from this job-specific assessment can then be compared directly with the requirements of the job. For a worker to be considered suitable for a particular job their physical capabilities must be equal to or greater than the demands of the job (Worth, 2000). The purpose of a PEFA is not to exclude individuals from employment but rather to place them into a job for which they are most suited. Randolph (2000) offers a good description of the rationale for a PEFA in the following terms:

It is axiomatic that fitting a square peg into a round hole is not only difficult, but damages either the peg or the hole. Similarly, placing an individual into a job for which he or she may not be physically qualified increases the risk to the employer and the employee of costly injuries. (p. 815)

The design of a PEFA typically consists of the following activities:

- physical and musculoskeletal screen
- fitness test
- postural tolerances and dynamic activities
- manual handling tasks

Physical Screening

Physical screening is typically used to identify any conditions such as elevated blood pressure or restricted limb movement which may prevent the worker from safely participating in the required functional tasks. They can also be used to screen for any current injuries or injuries common to the job for which they are applying (Scott, 2002). In the past, and unfortunately in many cases still today, trunk mobility and muscle strength are also tested in an effort to predict worker performance. There are numerous publications that refute the inclusion of these tests for this purpose alone. Mooney et al (1996) in a study of 152 shipyard workers found no evidence that isometric strength testing of back extensors would predict workplace back injury. Isokinetic back strength testing of a group of 171 nurses, as well as past history of reported pain, were also found to be poor indicators of low back pain or injury in work-related manual tasks (Mostardi et al, 1992). However, there may be some bias to this study in that only volunteers, and thus those with confidence in their performance, were tested. The assessors also acknowledged that the lifting activities in the study were controlled, whereas in a clinical setting they would be unpredictable and thereby likely to involve a heightened risk of injury. These results are not surprising considering that neither isometric nor isokinetic strength are functional measures of lifting performance. In contrast, Reimer et al (1994) makes a valid point in highlighting the fact that isokinetic testing is at least a reproducible assessment of range of motion lifting capabilities and uses the test in conjunction with dynamic lifting activities. In addition, a designer of any physical screening test needs to consider that isolated muscle strength tests are not job-specific and may not be justifiable under current anti-discrimination legal requirements.

Fitness tests

Fitness tests are designed primarily to determine whether the worker has the aerobic capacity to perform the required tasks based on aerobic requirements identified in the initial task analysis. Aerobic physical fitness not infrequently is included as predictor of physical injury. Numerous studies including a study of a group of 1652 firefighters by Cady et al (1979) have indicated that there is a graded protective effect for added levels of fitness against the incidence and cost of back injuries. Cady et al's measure of fitness was based on a total score from five items, including three of cardiovascular fitness, and one each for isometric back and leg strength and flexibility. They suggested that future studies may be able to determine if different components could be weighted separately to give more accurate predictions. Based on the previously discussed limited evidence to support isometric strength and flexibility testing, it appears that aerobic fitness may be a clearer indicator. A preliminary retrospective study by Bigos and Battié (1987) also indicated that low cardiovascular fitness level is a risk factor for chronic back pain disability.

Postural tolerances and dynamic activities

Postural tolerance and dynamic tolerance tests include activities such as reaching forward, squatting, stooping, climbing, walking and balancing. Again, their inclusion should be based on the job analysis. Procedures for assessing these tasks are extremely varied and their reliability depends greatly on standardized procedures for assessment. Information directly related to these tasks was scarce in the peer-reviewed published literature and could only be identified in product training manuals.

Manual handling tasks

There is a wealth of published information, and subsequent debate, about the methodology for, and validity of lifting assessments. There are two main topics of debate. Firstly, what comprises safe lifting? Secondly, which is a more accurate predictor of performance – isometric, isokinetic, kinesiophysical, functional, or isoinertial tests? In consideration of comments previously made about including assessment tasks consistent with actual work tasks, the kinesiophysical methodology would seem to be the most obvious choice. Battié et al (1989) in a four-year follow up study of 3020 voluntary aircraft manufacture workers failed to demonstrate that isometric lifting strength in either a torso, arm or leg lift position was indicative of an ability to predict that an individual was at risk of industrial back problems. Interestingly, partway through the initial testing phase, the torso lift (straight legs and bent forward position) was discontinued following a number of participant injuries. It is common knowledge that the power lift or a modified leg lift is the current preferred method for lifting.

The validity of the lifting component of the PEFA also relates to an ability to translate information obtained during the assessment relating to a participant's occasional lifting capacity (up to 33% of a workday) to that of a frequent lifting capacity (33% to 67%) or more. Saunders et al (1997) concluded that estimates of frequent lifting capacity can be made from occasional lifting capacity but that the usefulness of these estimates is questionable and such estimates should be used with caution. When these lifting assessments are transferred for application in an industrial environment there are additional limitations that need to be acknowledged.

Whilst it was not specified, these estimates are typically based on an 8-hour working day and as such may not be as easily transferred to a 12-hour working day which is becoming more common in labour-intensive industries such as mining and construction. The additional demands of awkwardness of loads, positions, team lifting and harsh environments have also not been taken into account. Ting et al (2001) found that work simulation tasks using the Baltimore therapeutic equipment (BTE) tended to overestimate the real lifting endurance performance in healthy men and thus caution should be exercised when transferring these results to real-life situations.

Utility

There are two concerns associated with utility ... "Does the functional test relate to job performance and does it meet the needs of the parties involved?" As previously discussed, the design of a valid PEFA is based upon an accurate task analysis of the job for which the participant is applying for. Therefore by meeting the requirement for task analysis and considering the issues of validity noted above, it can be assumed that the first component of this question will be addressed.

The developer of a PEFA must then determine, "What are the needs of the involved parties?" It may be anticipated that a worker's primary need will be for a safe test that will best display their current physical capacity to perform the key physical requirements of the job for which they are applying. For the employer, it could be anticipated that in addition to the key attributes outlined above, the provision of a cost-effective program for the promised results will take account of statutory legal obligations.

A recent study by Nassau (1999) followed the effects of a graduated program implemented at a large medical centre over 10.5 years in an effort to control the incidence and cost of work-related musculoskeletal disorders. The program consisted of three stages with the introduction of generic pre-employment musculoskeletal screens in the second stage (year two), and functional pre-work screens based on job demands introduced in the third stage (year six). The first stage was regarded as a control period. Nine hundred and five of the centre's one thousand eight hundred and eighty three employees were screened with the focus on those workers involved in 'heavier' manual tasks or from departments with a higher injury rate, such as nursing assistants. The results indicated that since the commencement of prework functional screenings, even though the frequency of injury was relatively unchanged, the severity of back sprains and strains and their associated costs were significantly lower in physically laborious jobs. It should be noted that case management and early return to work programs were also introduced over this period, and may also have also contributed to a lowering of the costs of work-related injuries. Scott (2002) describes a case study, involving a large industrial employer, that was undertaken in order to determine the cost-effectiveness of post-offer screening in reducing the number and costs of injuries post hire. Only those that passed the screening test were placed in the jobs on offer. Out of a total group size of 220 new hires evenly divided between those who had been screened and those who had not, the number (1% versus 23%) and resultant costs ($6,500 versus $2,073,000) of post-hire injuries was substantially less in the screened group. The physical requirements of the screening test were not identified. While these studies indicate positive benefits, more scientific research needs to be conducted into the utility of pre-employment functional assessments.

CONCLUSION

Provided the limitations of a PEFA are addresses in the design phase, the positive impact of such programs is potentially a classic "win-win" situation – the employee benefits by avoiding an injury, and the employer benefits by avoiding the primary and secondary costs of workplace injuries (Randolph, 2000). In addition to the reduction in work-related musculoskeletal injuries and their associated costs, there are additional advantages to pre-employment functional assessments when they are applied in an appropriate manner. These include: the confirmation of the worth of an occupational health professional to an organisation by successfully matching employees to suitable jobs; as well as the potential for task and equipment modification to be implemented in physically demanding jobs. These two benefits alone should increase the pool of suitable candidates and thereby further reduce the risk of work-related musculoskeletal disorders.

RECOMMENDATIONS

Snook (1987) offers a useful summary of the value and limitations of pre-placement testing:

"Pre-placement testing and selection of workers can make a significant contribution towards reducing musculoskeletal injuries, but it must be supplemented by training, ergonomics, appropriate treatment, enlightened management, and cooperative unions".

Whilst there is some evidence for the use of pre-employment functional assessments as a tool for controlling work-related musculoskeletal disorders, there is still a large gap in the knowledge surrounding their effectiveness. Some key areas for additional research regarding this topic include, but are not limited to:

- validation of various test components for inclusion as predictors of performance
- identification of additional items for testing to assess indicators for risk of work-related musculoskeletal disorders other than back injury, and also as predictors of performance
- identification of the relationship between predictors of performance and risk of work-related musculoskeletal disorders
- consensus regarding 'safe lifting technique'
- understanding of the needs and expectations of consumers of pre-employment functional assessments.

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