

REVIEW

PEN AND PAPER BASED OBSERVATIONAL METHOD TO ASSESS POSTURAL PROBLEMS: A REVIEW

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ABSTRACT

Posture is one of the most important factor that need to be considered in any postural analysis. Awkward, extreme, and repetitive postures can increase the risk of musculoskeletal disorders (MSDs). As observational methods are more widely used than instrumentation-based methods to assess postural problems, this study reviews and assesses the scientific literature of observational methods and focused on pen and paper based specifically. In order to identify the published methods, a list of English or Malay articles dating as far back as 1990 was compiled from PubMed, Science Direct and Google Scholar. The keywords were ergo*, posture*, method*, observational*, postural problems*, pen and paper*, posture analysis*, indirect* and macro-ergo*. In addition, a secondary search was also performed using bibliography of retrieved articles so that additional papers for conducting review and evaluations can be collected. A total of 121 articles that assessed postural problems in working activities were found. However, after intensive screening process only 6 articles were selected to be further analyzed. Posture of upper arms/shoulder, lower arms/elbow, wrist, neck, back/trunk and leg were highlighted in this study. The limitations and the strengths of the published pen and paper based observational method focusing on those postures were also discussed. The finding of this review will benefit researchers in the process of understanding unsafe posture in workplace. It could also provide to researcher on how to improve the current pen and paper based observational method for assessing postural problems.

Keywords: posture, observational method, pen and paper based.

INTRODUCTION

Safe working posture throughout daily working hours is an important factor to maintain health. However, in reality, to have such posture is almost impossible especially in physically demanding work task¹. In agricultural work for example, postural problems are common. Tapping of rubber trees at a low level among rubber tappers², tapping rubber trees above head level due to the condition of tree (old tree)³, working with hands above shoulder height among women farmers⁴. Other factors such as squatting and kneeling⁴, operating vibration tools^{4,5} work pace, twisting, repetitive or static posture also found significant to MSDs⁵. Because of that issues, many researchers had put an effort to study on ergonomics exposure measurement technique to assess strain in muscle and joint among workers^{6,7}.

Corlett et al.⁸ mentioned that human movement is one of the most important factors that need to be considered in work load assessment. In doing activities (job tasks) whole body is involved at most of the time. So, method to assess whole body posture are selected to be further discussed⁹. Dynamic and whole body posture assessment methods are then were filtered to pen and paper based observational method due to the reasons of the ability of those methods to handle posture data in real time, and the

avoidance of observer bias, as body movements can be recorded without the presence of an observer¹⁰.

Other important issues that need to be emphasized in each observational methods are the reliability and validity study. To have reliable and valid method is important so that the association between occupational risk factors and health outcomes could be determined¹¹. However, studies found that the factor of reliability and validity in current published assessment techniques have not been much tested during the development process¹²⁻¹⁶. This issue is vital. Failure to effectively test the reliability and validity of the assessment techniques will lead to the uncertainty on the gathered assessment results regarding to work related musculoskeletal disorders¹³⁻¹⁶. Thus, the aim of this study is to identify published pen and paper based observational methods for assessing working posture including its reliability and validity study.

METHODS

In order to identify the published methods, a list of English or Malay articles dating as far back as 1990 was compiled from PubMed, Science Direct and Google Scholar. The keywords were ergo*, posture*, method*, observational*, postural problems*, pen and paper*, posture analysis*,

indirect* and macro-ergo*. In addition, a secondary search was also performed using bibliography of retrieved articles so that additional papers for conducting review and evaluations can be easily collected.

RESULTS AND DISCUSSION

A total of 121 articles that assessed postural problems in working activities were found. However after intensive screening process only 6 articles regarding dynamic and whole body the pen and paper based observational method to be further analyzed. Meanwhile, other methods that focused on upper limbs and manual handling activities for example, were excluded. The selected methods are WERA by Rahman et al.¹⁷, QEC by David et al.¹⁸, REBA by Hignett and McAtamney¹⁹, OWAS by Karhu et al.²⁰, PATH by Buchholz et al.²¹ and PLIBEL by Kemmlert²². All the six methods are explained in the following paragraphs.

Workplace Ergonomic Risk Assessment (WERA)

Workplace Ergonomic Risk Assessment (WERA) is a tool developed by Rahman et al.¹⁷. The WERA assessment consists of six physical risk factors including posture, repetition, forceful, vibration, contact stress and task duration and its involve the five main body regions (shoulder, wrist, back, neck and leg). It has a scoring system and action levels which provide a guide to the level of risk and need for action to conduct more detailed assessments. WERA assessment provided a good indication of WMDs which might be reported as pain, ache or discomfort in the relevant body regions and its reliability is moderate¹⁷. WERA assessment also has been proved that easy and quick to use, applicable to workplace assessment for the wide range of job/task and valuable at work study.

Rapid entire body assessment (REBA)

Rapid Entire Body Assessment (REBA) by Hignett and McAtamney¹⁹ was developed on the basis of RULA system²⁰. Using REBA, observer have to select the activity to be assessed¹⁰. Overall score for all body parts (trunk, legs, neck, shoulder, arms and wrist) are gained using REBA diagrams. Additional factors such as coupling also considered in the assessment. At the end of the assessment, action levels are provided. Application of REBA can be seen in the study of Janowitz et al.²⁵ and Jones & Kumar²⁶.

Quick exposure check (QEC)

Quick Exposure Check (QEC) is a tool developed at the Robens Centre for Health Ergonomics in the United Kingdom and enhanced for several times²⁷. The tool was tested in term of its

validity and reliability in the original tool development using simulated and workplace tasks^{28,9}. Both intra-observer and inter-observer were found high in term of sensitivity and reliability¹⁰. Four main body areas (back, wrist/arms, shoulder/hand, neck) can be assessed. Other factors such as psychosocial factors, movement (i.e. static/dynamic), frequency, subjective forces, weight handled, vibration and shift also included. In QEC, the assessment combines the observer's assessment with the worker's answers^{30,27,31} indirectly participatory ergonomics is involved²⁸. At the end of the assessment, QEC also has scoring system for all exposure levels.

PATH (Posture, Activity, Tools and Handling)

Posture, Activity, Tools and Handling (PATH), a work sampling-based approach, was developed²¹. The posture codes in the PATH method are based on OWAS by Karhu et al.²⁰, with other codes included for describing worker activity, tool use, loads handled and grasp type. PATH method is found to be reasonably valid and reliable in a preliminary study²¹. PATH assessment able to characterize the proportion of time workers spend in awkward postures, handling loads, and performing manual materials handling and other activities within job tasks, as well as the frequency distribution of job tasks during non-routinized types of work³².

A Method Assigned for identification of ergonomics hazards (PLIBEL - Plan för Identifiering av Belastningsfaktorer)

PLIBEL is an observational checklist to identify ergonomics risk factor for MSDs. It was developed by Kemmlert²². The method consist of questions regarding posture, workplace and tool used. In PLIBEL the observer have to answer the checklist according body regions. Neck/shoulders and upper part of back, elbows/forearms and hands, feet/knees and hips, and low back and the concerned body region that include in the assessment method.

Ovako working posture assessment system (OWAS)

OWAS was developed in a steel company by Karhu et al.²⁰. OWAS observes weight of the load handled (three categories) and postures of the back (four postures), upper arms / shoulders (three postures), and lower extremities (including the hip, knee and ankle), (seven postures). It is valid to perform OWAS either by direct observation or video observation³³. Between OWAS and perceived postural problems and discomfort are well associated³⁴. OWAS is widely used and well documented⁹ and many case studies of ergonomic applications have been reported³⁴⁻³⁶.

The result of reliability and validity study of the selected pen and paper based observational methods is presented in Table 1. Each method has different strategy in observing ergonomics risk factors associated with MSDs.

The pen and paper based observational methods and the covered body regions is presented in Table 2. Based on the literature reviews, only REBA covers all the body regions (upper arms/ shoulder, lower arms/ elbow, wrist, back/trunk and leg). Many study found that working with

lower arm / elbow above shoulder height is associated with muscle fatigue / shoulder pain³⁷⁻⁴⁰. Unfortunately the lower arm assessment was not included in WERA and QEC method. For OWAS, the assessment of wrist is missing although flexion and extension activity in unsafe condition is harmful to the wrist area⁴¹⁻⁴³.

Table 1 - Reliability and validity of pen and paper based observational methods

Method	Year	Observation Strategy	Reliability (R)	Validity (V)
Workplace ergonomics risk assessment (WERA)	2011	Sum score of weighted items	Moderate	Good (compared with self-reported discomfort)
Rapid entire body assessment (REBA)	2000	Sum score of weighted items	Moderate	Moderate (compared with method OWAS)
Quick exposure check (QEC)	1999	Sum score of weighted items	Moderate	Good (compared with video, technical measure)
Posture, activity, tools and handling (PATH)	1996	Time spent in postures	Low	Moderate - good (compared with video, technical measures)
A method assigned for identification of ergonomics hazards (PLIBEL)	1995	Yes / No answer; Profiles of items	Moderate	Moderate (compared with method AET)
Ovako working posture assessment system (OWAS)	1977	Time sampling	Good	Moderate (compared with discomfort, technical measure)

Notes:

(R) Inter -observer reliability

During the development process, how well does the method can achieve the same score for their assessment made by different observers?- (Good, Moderate, Low)

(V) Validity - During the development process, how well does method correspond with more valid method/s- (Good, Moderate, Low)

Table 2 - Pen and paper based observational method to assess posture and the body region

No	Method	Body Region					
		Upper arms / Shoulder	Lower arms / Elbow	Wrist	Neck	Back / Trunk	Leg
1	Workplace ergonomics risk assessment (WERA)	✓	0	✓	✓	✓	✓
2	Rapid entire body assessment (REBA)	✓	✓	✓	✓	✓	✓
3	Quick exposure check (QEC)	✓	0	✓	✓	✓	0
4	Posture, activity, tools and handling (PATH)	✓	0	0	✓	✓	✓
5	Plan för identifiering av Belastningsfaktorer; A method assigned for identification of ergonomics hazards (PLIBEL)	✓	✓	0	✓	✓	✓
6	Ovako working posture assessment system (OWAS)	✓	✓	0	0	✓	✓

CONCLUSION

In this study, 6 pen and paper based observational method to assess whole body posture were reviewed. Result showed that, current published methods still have limitation. Although the selected methods have been tested of their reliability and validity the limitation is obvious in term of missing in the assessment of lower arm region and wrist posture in the assessment. As conclusion, the findings of this review will benefit researchers in the process of understanding unsafe posture in workplace. It could also provide to researcher on how to improve the current pen and paper based observational method for assessing postural problems.

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COMPETING INTERESTS

There is no conflict of interest.

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