

## RELIABILITY OF ASSESSING HAND ACTIVITY

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### Abstract

Work-related musculoskeletal disorders may be caused, precipitated, or aggravated by repeated exertions with the hand (1). One tool used to assess hand activity is the ACGIH's hand activity level (HAL) rating scale (2). However, quantifying postures and exposure times for the hand is problematic. The purpose of this study was to determine the reliability of using a software package in assessing hand activity. Four male university subjects were formally trained, instructed to observe a video tape and tally the hand exertions noticed using the software. Each subject performed this procedure 3 times. Excellent reliability was observed in 3 subjects (Intra-Subject analyses ICC = 0.93 - 0.99) while the 4<sup>th</sup> was poor (ICC = 0.17). The Inter-Subject analysis also had a poor reliability (ICC = 0.27). The ICC scores indicates that it is possible to reliably assess hand activity using this software. However, the low Inter-Subject ICC score indicates subjects interpreted hand postures differently.

**Keywords:** Hand Activity, Reliability, Video Analysis

## FIDÉLITÉ DE L'ÉVALUATION DE L'ACTIVITÉ DE LA MAIN

### Résumé

Les nuisances musculo-squelettiques peuvent être causées ou aggravées par des efforts de préhension répétés (1). L'évaluation de l'activité de préhension se fait à l'aide de l'échelle (HAL) du ACGIH (2). Néanmoins il est difficile de quantifier le positionnement et le temps que la main sera exposée aux efforts. Le but de cette étude était de déterminer la fiabilité d'un logiciel pour évaluer l'activité de préhension. Quatre étudiants universitaires ont été éduqués sur l'utilisation du logiciel. Ils ont été dirigés à observer un vidéo et de compter les efforts de préhension aperçus avec le logiciel. Chacun a complété cette tâche 3 fois. La fiabilité était excellente pour trois d'entre eux (analyse intra-sujet ICC = 0,93 - 0,99) cependant le quatrième était faible (ICC = 0,17). Pareillement, la fiabilité inter-sujet était faible (ICC = 0.27). Le score "ICC" indique qu'il y a possibilité d'évaluer avec fiabilité l'activité de préhension utilisant ce logiciel. Cependant le score ICC indique que chaque étudiant avait une interprétation de la position de la main différente.

Mots Clefs: Activité de Préhension, Fiabilité, Analyse Vidéo

## INTRODUCTION

It has long been suggested that work-related musculoskeletal disorders (WRMSDs) such as carpal tunnel syndrome and tenosynovitis can be caused, precipitated, or aggravated by repeated exertions with the hand (1). One tool used to assess hand activity is the American Conference of Governmental Industrial Hygienists' hand activity level (HAL) rating scale. However, quantifying postures and exposure times for the hand is problematic. Neumann et al (1998) reported that pencil and paper checklists are not able to quantify postures and exposure times reliably for small, fast moving body parts (e.g. hand/wrist). Thus researchers have focused on methods to help quantify hand exertions in the workplace as a means to assess the risk of WRMSDs. One software based video observational method which appears promising is The Observer<sup>®</sup> (Noldus Information technology, The Netherlands, 1996). The purpose of this study was to determine the reliability of using The Observer software package in assessing hand activity.

## METHODS

Four male university subjects were formally trained in using The Observer software. For this specific study each subject was provided with a set of figures depicting each of the hand postures they were to tally. Prior to testing a group discussion was initiated to reach a single interpretation on each of the postures in the template. The material chosen for observation was a one cycle of a job associated with an automotive assembly operation. The content of the video was chosen for its distinctly visible hand postures and large number of different tasks within the job.

Thirty-two possible hand postures (sixteen for each hand) could be recorded and these were entered into The Observer software. Each posture was assigned a keyboard letter and a mouse activated push button. To record the occurrence of a hand posture the user simply entered the corresponding keyboard letter or used the mouse to point to and click the corresponding push button. The software only permits one hand posture for each hand to be recorded at a time (i.e. a hand cannot perform two grips at the same time). Subjects were allowed to manipulate the speed of the video and to rewind the video to a desired location. Each subject was instructed to observe the video on a monitor and tally the hand exertions noticed using The Observer. Each subject performed this procedure 3 times with a rest duration of 15 minutes between trials.

In order to determine the intra-subject intra-class correlation coefficient (ICC), the frequencies of exertions for each hand posture were extracted directly from the software and an intra-subject ICC for frequency was then calculated from each subject. These frequencies were also used to calculate an inter-subject ICC.

## RESULTS

The ICCs were interpreted as follows: poor reliability ICC < 0.4, fair to good reliability for 0.4 < ICC < 0.75, and excellent reliability for ICC > 0.75 (2).

The reliability of 3 of the 4 Intra-Subject analyses are interpreted as excellent while the 4<sup>th</sup> was poor (Table 1). The Inter-Subject analysis also had a poor reliability (Table 1).

Intra Subject	ICC	Reliability Rating
1	0.17	Poor
2	0.99	Excellent
3	0.99	Excellent
4	0.93	Excellent
Inter-Subject	0.27	Poor

Table 1: Intra- and Inter-Subject Intra Correlation Coefficients (ICC) for 4 subjects rating frequency of exertions of different grips for the right and left hands.

## DISCUSSION

The range of intra subject ICC scores indicates that it is possible to reliably use The Observer software to assess hand activity. However, the low Inter-Subject ICC score indicates that in this study the subjects interpreted hand postures differently. This variability may be due to the training the subjects received at the start of the study. Computer generated diagrams were used to illustrate the specific hand postures. However, the diagrams were hand skeletons and not actual pictures of intact human hands. Therefore, even though the subjects were clear on the interpretations of the computer generated diagrams given to them at the start of the study, they were not clear on how to identify these hand exertions when viewing a video of a living human hand performing work.

To correct this a more comprehensive training program is being developed. This program will incorporate video to allow users to become familiar with living human hand postures which reflect the ones observed when assessing a job. A training video not only offers a precise reflection of specified hand postures, but also offers contextual knowledge. These videos will also allow a user to perform practice tests and once an individual achieves a specific reliability and accuracy then they can begin to quantify hand postures and exposure times for ergonomic purposes.

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