THE UTILITY OF OWAS IN AUTO MANUFACTURING ASSEMBLY JOB EVALUATIONS

Richard F. Sesek, University of Utah
David Gilkey, Colorado State University
John Rosecrance, Colorado State University
Alexandra Guzy, Colorado State University

ABSTRACT

This pilot study evaluated 31 jobs using the Ovako Working Posture Analysis System (OWAS), a posture based ergonomic tool to evaluate risk in jobs with known health outcomes. The specific aims of this project were to: 1) investigate the utility of OWAS ergonomic assessment in the evaluation of automotive manufacturing jobs, 2) identify the sensitivity and specificity of OWAS to accurately identify known risk levels for a specific set of automotive manufacturing jobs, and 3) develop data that may validate the OWAS ergonomic assessment tool for automotive industry use. Investigators found little utility for auto assembly work evaluation.

BACKGROUND

It is estimated that between 60 and 80 percent of the general population will suffer from low back pain at some point in their lives, and 5-30 percent are suffering from it at any given time (Cassidy, 1988). Guo et al (1999) reported that 22.4 million cases of back pain will occur annually affecting 17.6% of the general US population, and that 65% are work related. Back pain is America's number one safety and health workplace challenge (OSHA, 1993). The economic impact of back pain includes direct and indirect costs that are estimated as high as $100 billion annually (BNA, 1993; Marras, 1999; Marras, 2000). There exists a preponderance of evidence suggesting that ergonomic risk factors of excessive force, high repetition, and awkward posture are causally related to the onset of musculoskeletal disorders (MSDs) of the upper extremities and back (NIOSH, 1997). Multiple ergonomic tools have been designed and tested to estimate risk levels for MSDs in a wide variety of manufacturing and office settings. The Ovako Working Posture Analysis System (OWAS) is one such ergonomic assessment tool used for over 30 years to estimate risk of MSDs (Karhu, 1977). OWAS has been shown to be an effective method for analyzing jobs and estimating the risk of injury in many different types of industries (Kivi, 1991; Li, 2000; Mattila, 1992). OWAS is posture-based technique that is used to evaluate job-task demands and classifies jobs into risk categories known as "Action Categories" 1 – 4 ranging from 1, which means no increased risk, to 4, which means that severe harm is likely (Karhu, 1977). However, OWAS has not been used to investigate automotive manufacturing assembly jobs. This project investigated the utility of OWAS to accurately identify risk levels for jobs with known health outcomes in an automotive manufacturing environment.

METHODS

Data were analyzed from a subset of a database consisting of 667 manufacturing jobs collected from the automotive industry in a prior study. The database included historical injury data for jobs previously analyzed, as well as symptom interviews and basic medical exams for approximately 1100 subjects. These jobs had been videotaped for subsequent data analysis. Approval for accessing this ergonomic database was granted by both the automotive company and its union representation. All participants signed informed consent documents before participating in the original study. This consent allowed for subsequent use of the videotapes for instructional and research purposes. Institutional Review Board (IRB) approval to review a sampling of these videotaped jobs was obtained for this study.

Ergonomic data for the videotape database were collected at six different automotive plants with a mix of operations ranging from component manufacturing to vehicle assembly. Jobs that were not primarily related to manufacturing, such as administrative jobs, or jobs that did not have well defined tasks or relatively short cycle times, such as trouble-shooters and maintenance personnel, were not included in the original study.

The parent automotive company maintains occupational injury data. The company uses the injury database to perform occupational medical surveillance of its manufacturing facilities and to identify areas or departments where injuries may be a concern. Injury data used in this study were historical and included low back, neck and shoulder, and distal upper extremity (DUE) related first-time medical visits for a one-year period retrospectively from the date of the data collection.

For the purposes of this study, jobs were broken into the following four categories: (1) “controls” were jobs with no reported symptoms and no injuries for the previous year; (2) “low back cases” included jobs with at least one low back injury in the previous year and current reports of symptoms; (3) “neck and shoulder cases” were jobs with a neck or shoulder injury and symptoms; and (4) “distal upper extremity cases” including jobs with DUE injuries and symptoms. There were a total 31 jobs evaluated consisting of 5 controls, 8 low back cases, 9 neck and shoulder cases, and 17 DUE cases. Some subjects represented multiple cases (i.e., both DUE and low back injury).

The OWAS analysts at Colorado State University (CSU) were blinded to job category assignment. All 31 video recordings of assembly jobs were viewed and evaluated in the Ergonomics Laboratory at CSU by a trained research assistant. Each job-task was viewed through at least 10 full job-task-cycles to ensure capture of postural demands. Arm, torso, and leg position were recorded every 30 seconds as well as weight of load. OWAS data were compared to the health outcomes obtained in the original study by researchers at the University of Utah. OWAS risk categories were compared to actual health outcomes to determine if OWAS could differentiate between cases and controls. OWAS Action Categories (AC) are as follows: AC 1 = “normal posture, no action required and no increased risk for MSD;” AC 2 = “posture is slightly harmful, actions to change postures should be taken in the near future, workers exposed are at increased risk for MSD;” AC 3 = “posture is distinctly harmful, actions to change postures should be taken as soon as possible, risk of MSD is significant;” and AC 4 = “posture is extremely harmful, actions to correct postures should be taken immediately, injury is imminent" (Tampere University, 1992). Jobs classified as low risk, including OWAS AC 1 and 2, were used as control jobs, whereas jobs classified as AC 3 and 4 were considered high-risk cases.

RESULTS

Based upon the results of this pilot case-control study, it appears that OWAS does not identify low versus high-risk automotive assembly jobs well. In fact, only one job had 6% of the job classified in the AC 3 category (a neck/shoulder case). OWAS did not classify any portion of any job in the AC 4 category. Table 1 shows differences between the study groups.

Table 1. OWAS Classification of Automotive Assembly Jobs by Percent of Time in AC

	Percentage time in each category (standard deviation)			
Job Categories	**Category 1**	**Category 2**	**Category 3**	**Category 4**
Clean Controls (5)	84 (12.5)	16 (12.5)	0	0
Low Back Cases (8)	77 (12.8)	23.3 (12.9)	0	0
Neck/Shoulder Cases (9)	72.3 (25.2)	27.2 (25.8)	0.7 (2.0)	0
DUE Cases (17)	81.2 (22.2)	18.9 (22.1)	0	0

When comparing controls and cases for individual OWAS risk factors, only the "percentage of time spent with the back straight" was significantly different and only for the low back cases. Controls had "straight backs" for 84% (standard deviation 12.5) of their work cycles and low back cases had "straight backs" for 67.9% (standard deviation 11.6) of their respective work cycles ($p=0.037$).

DISCUSSION

The results of this pilot study indicate that OWAS lacks the sensitivity to classify the actual risk related to automotive assembly jobs. The risk factors that make these automotive jobs hazardous simply do not appear to be captured well by the current OWAS. While there appears to be some differences in the percentage of time spent in the various risk categories, there is significant variation within each group and there are no statistically significant differences between job categories. It is important to reiterate that OWAS did not classify any of the jobs as distinctly risky yet injury outcome data suggest otherwise. Using these non-statistically significant differences in AC 1 and 2 percentages to differentiate between cases and controls is not recommended, and would, in fact, be using the OWAS tool in a manner inconsistent with the OWAS risk category recommendations. OWAS risk category 2 states that "the posture is slightly harmful, actions to change postures should be taken in the near future." Action Categories (ACs) classify the relative risk and urgency for intervention to prevent musculoskeletal disorders due to exposure, especially the low back.

OWAS was first used as an ergonomic evaluation tool in the Finnish Steel industry (Karhu, 1977). This type of work was very physically demanding and had high levels of reported MSDs. The posture–based approach was developed to evaluate the relationship between exposure, risk, and outcome. It performed well with OWAS data being used in ergonomic decision making, resulting in improved job-task design with reductions in risk and injury outcomes (Karhu, 1981).

Subsequent applications of OWAS included manufacturing (Vikki, 1993), construction (Lee, 1996; Doormaal, 1995), and healthcare industries (Engles, 1994; Kant, 1992).

One study by Kivi and Mattila (1991), who evaluated 12 jobs and 39 essential tasks in commercial construction, identified jobs in AC 3 and 4 with cement, repair, concrete worker, and bricklayers trades exceeding 10% of job-tasks time in the highest risk AC. Workers in these trades perform many tasks while bent forward and at ground level, but have much greater mobility and postural variation in the course of their workday, as well as lifting and handling greater weights than do automotive assembly workers. Work done in the kneeling position that requires excessive and prolonged forward reaching might also reveal higher AC ratings.

In another study using OWAS, Li (2000) evaluated commercial construction workers in Taiwan. He also characterized OWAS findings as percent of time in harmful postures including ACs 2 - 4. He found the following: form work 32.4%, iron work 35.9%, cement work 36.1%, and scaffold work 43.3%. If one considers that recovery from slight harm is more readily achieved than from higher risk categories, AC 2 is of less concern. Over one-half of the carpenter's time is spent in slightly harmful postures (Mattila, 1993). The bulk of the remaining time is categorized as normal postures and thus facilitates recovery. This may be a fallacy. In fact, the cumulative effects of exposure may pose greater risk than realized. Future research in this area might include sampling of the entire workday.

The OWAS assessment tool, as described in this pilot study of auto assembly, is less useful compared to success reported by other investigators looking at jobs with greater postural variation and loads. Estimating risk using the optimum cutoff of 75% results in an odds ratio of 6.9 (1.1 – 42.8 95% CI). The 95% confidence interval suggests that the actual odds ratio may be quite modest (e.g., just over 1.0). Also, the positive predictive value is only 46% resulting in an unacceptably high percentage of "false positives."

In summary, based on this pilot study, the OWAS tool cannot be recommended for evaluation of automotive assembly tasks at this time. Further research is planned to determine more definitively if OWAS can be used to evaluate these tasks. In addition, the authors intend to explore alternate combinations of the OWAS intermediate outputs for prediction of injuries in automotive manufacturing environments.

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