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## AN OBSERVATIONAL TOOL TO ASSESS WORK ORGANIZATIONAL FACTORS

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In a large 5-year prospective study of work-related upper extremity musculoskeletal disorders (UEMSDs), conducted by the SHARP Program in Washington State, an observational tool was used to assess the organization of work in twelve worksites in the health care and manufacturing industries. The tool, a two-page checklist, assessed the physical, social and temporal aspects of the work, and the global and task level job content. A comparison between industry sectors found variability. Significant associations between industry sector and both structural restraints of the task activities ( $p < 0.0001$ ) and pacing determinant ( $p < 0.0001$ ) were found. Several work organizational factors were negatively correlated including labor skill level and pacing determinant ( $-0.51$ ,  $p < 0.0001$ ). Other work organization factors were positively correlated such as social content and pacing determinant ( $0.62$ ,  $p < 0.0001$ ). These data will be used to investigate the relationships between physical, psychosocial, work organizational and individual factors and the risk of UEMSDs.

### INTRODUCTION

The Safety and Health Assessment and Research for Prevention (SHARP) Program of the Washington State Department of Labor and Industries is in the last year of a large prospective study of work-related upper extremity musculoskeletal disorders in industry (NIOSH Grant No. U01 OH 007316). This five-year prospective study (SHARP UEMSD Study) combines individual health history, psychosocial factors, disability, physical exam and nerve conduction testing with individual physical work exposure and work organizational assessments over time. A cohort of 733 subjects from 12 different worksites in the manufacturing and health care industry sectors has been followed for over three years (Silverstein et al, 2002). This study will allow the identification of specific interactions between multiple physical, psychosocial, organizational and individual factors and evaluate how they increase or decrease the risk of work-related upper extremity musculoskeletal disorders.

In the SHARP UEMSD Study, the work environment is being assessed through several methods. Extensive biomechanical exposure measurements have been collected to characterize the physical workload of individuals (Bao et al. 2000). The psychosocial

environment has been assessed via a questionnaire developed by SHARP, The Perception about Work and Health Questionnaire (Silverstein et al, 2002). The final aspect of the work environment that has been assessed in the SHARP UESMD Study is the organization of work, an aspect of the work environment that has not been commonly considered in epidemiologic research of the development of musculoskeletal disorders. A single definition of work organization has not been formally adopted, however, NORA (2002) defines the organization of work in three contexts; 1) the external context such as economic, political and technological factors, 2) the organization context which includes the management structure, the supervisory methods and production methods, and 3) the work context which includes temporal aspects, social aspects and task complexity. In the SHARP UEMSD Study, an observational work organization tool was used to capture these factors.

The intent of the tool is to allow the objective assessment of the organization of work at the group level, through observations, in a brief period of time. These characteristics can be lacking in other work organizational assessment methods. The Quality of Employment Survey (Quinn and Shepard, 1974) and the National Organizations Survey (Kalleberg et al, 1996) are examples of questionnaires that assess the organization of work. These surveys, though they differ

in their definitions and measurements of factors, assess the work organization at the individual level and through non-observational methods. Observational survey instruments that assess the workplace at the global level most often assess the physical environment and the physical workload. The AET, developed by Romert and Landau (1983), provides a universal analysis of the work system and the content of work. This instrument involves 216 items and can take 2-3 hours per job to complete observations and interviews. The EWA or Ergonomic Workplace Analysis (Ahonen et al, 1989) assesses the workplace according to 14 different aspects and can take between 15 minutes (for simple, familiar tasks) to half a day (for a beginner analyzing a complex job).

The data collected from the observational work organization tool will be used in the SHARP UEMSD Study in two ways. The data will be used in the investigation of the relationships between the organization of work, the psychosocial environment and the physical environment and their role in the development of musculoskeletal disorders. Secondly, the data will be used to investigate the co-relationship between the organization of work and psychosocial factors. MacDonald et al (2001) found correlated physical and psychosocial factors of the job were related to the structural organization of work. These correlations are not often considered when interpreting results of studies that include both these aspects.

This paper describes the observational work organization tool used in the SHARP UEMSD Study, the data collection methods of the tool used and presents preliminary analysis results: the correlations between work organization factors and comparisons of the organization of work within the health care and manufacturing industry sectors.

## METHODS

In the SHARP UEMSD Study, the work organization tool, a 2-page checklist, categorically characterizes work organization factors through observations. Table 1 describes a sample of the work organization factors observed. The tool was developed for the NIOSH WMSD Research Consortium (MSCD) and adjusted for the needs of the SHARP study. The tool includes similar factors from previously developed job analysis methods including AET (Rohmert and Landau, 1983) and the Ergonomic Workplace Analysis, EWA, (Ahonen et al, 1989). The intent of the checklist

is to characterize several aspects of the organization of work. These aspects are:

- A) The physical aspects of the work (temperature, humidity, illumination, noise, general housekeeping)
- B) Job content at the task level (repetitiveness, pacing, pacing control, job rotation, labor type, postural demands)
- C) The social aspects of the work (group coordination, gender segregation)
- D) Global job content (attentiveness demands, use of skills, mental demands, structural restraints of task activities)
- E) Temporal aspects of the work (work hours, break schedule, shift work)

In the SHARP UEMSD Study, two industry sectors were involved, manufacturing and health care, not involving patient care. Work organizational data was collected at participating sites in each department in which a study participant currently worked in. Checklists were completed by three ergonomists from the SHARP Program and departments were randomly assigned to one ergonomist. Initial training for the ergonomists involved discussions and consensus of definitions of variables on the checklist. This process required very little time (approximately 1 hour). Completion of the checklist took approximately 10 minutes per department, including brief questions to workers or supervisors to documents aspects of the work environment not readily observable such as shift length, job rotation and pay type.

For the preliminary analysis, data collected from 130 departments from 12 worksites, three from the health industry sector and nine from the manufacturing industry sector, were used. Chi-square tests of association were performed between the two industry sectors with a sample of work organizational factors. Additionally, Spearman correlation coefficients were calculated to investigate the relationships between work organizational factors.

## RESULTS

The results of the comparison of work organizational factors between industry sectors showed variability in some factors. Figure 1 displays the variability in two work organization factors. Significant associations were found between industry sector and structural restraints of the task activities and pacing determinant ( $p < 0.0001$  and  $p < 0.0001$ , respectively).

Also, as shown in Figure 1, manufacturing jobs had much stronger structural restraints than health care jobs. In 75% of the departments in the health care sector, the work pace was self-determined as compared to approximately 20% of the departments in the manufacturing industry.

Table 2 shows the statistically significant correlation coefficients between work organizational factors. Labor skill was negatively correlated to most other work organizational factors including social content, pacing determinants, responsibility for the safety of others, job structural restraints, noise and housekeeping. Social content of the job was also negatively correlated to job structural restraints, attention demands and method of work but was positively correlated to pacing determinants, responsibility for the safety of others, noise and housekeeping. The pacing determinant of the job was positively correlated to the responsibility for the safety of others, job structural restraints, noise and housekeeping.

## DISCUSSION

There appears to be variability among some work organizational factors between industry sectors. This suggests that the work organization tool is sensitive to detect exposure differences and there is sufficient variation among industry sectors' worksites. In the SHARP UEMSD Study, participating sites in the health care industry included jobs such as hospital launderers, medical transcriptionists, hospital cafeteria staff, biomedical researchers and office staff. However, similar types of jobs were also evaluated at the participating sites in the manufacturing industry. For example, office jobs were assessed in both industries. Additionally, at the task level, jobs within each industry may have similar characteristics such as no job rotation and very little task variability.

As noted by MacDonald et al (2001) multi-collinearity between measures of psychosocial, physical and work organizational factors may exist. From the data, there appears to be strong correlations between work organizational factors. However, further analyses are necessary to evaluate the relationship between correlated factors. With further investigation and development of the work organization tool, it may be possible to measure factors commonly associated with the psychosocial environment, such as job control and supervisory support, through the observation of the organization of work. This could provide objective,

group level data that can be used in the determination of risk of the development of musculoskeletal disorders.

The observational work organization tool has several advantages over other psychosocial and work organizational surveys. This tool does not require the removal of workers to complete the survey, eliminating the impact on productivity. In addition, the tool requires only one person to complete, reducing the man-power required. And while this tool is by no means as extensive as the AET, it does not take hours to evaluate one job by a trained observer. Further development of the tool is continuing. Inter- and intra-reliability analysis will be completed as well as the examination of the correlations between work organizational and psychosocial factors. In the SHARP UEMSD Study, modeling of work organizational factors with work-related musculoskeletal disorder prevalence, incidence and persistence will be analyzed.

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Table 1. Examples of Work Organization Tool Items

<b>WORK ORG FACTORS</b>	<b>Categories</b>					
<b>PHYSICAL ASPECTS</b>						
<b>Lighting</b>	Adequate	Too Bright	Too Low for Task			
<b>Noise</b>	Normal Talk	Yell	Hearing Protection			
<b>Housekeeping</b>	Very Good	Good	Bad	Very Bad		
<b>TASK LEVEL JOB CONTENT</b>						
<b>Labor Content</b>	Non-skilled	Semi-skilled	Skilled Manual	Skilled Trade	Professional	
<b>Work Method</b>	Assembly Line	Work Cells	Desk Work			
<b>Task Variability</b>	Single Task/Activity	Single Task/Multiple Activities	Multiple Activities			
<b>Pacing Determinants</b>	Self	Social/Peer	Machine	Line	Piece Rate	Quota
<b>GLOBAL LEVEL JOB CONTENT</b>						
<b>Attentiveness Demands</b>	Superficial	Average	Somewhat High	Very High		
<b>Responsibility for the Safety of Others</b>	Does Not Apply	Very Limited	Limited	Average	Significant	Very Significant
<b>Structural Restraints of Task Activities</b>	Very Minor Structural Restraints	Little Structural Restraints	Average Structural Restraints	Strong Structural Restraints	Very Strong Structural Restraints	
<b>SOCIAL ASPECTS</b>						
<b>Social Content</b>	Individual	Work Team, Min. Coordination	Work Team, Mod Coordination	Work Team, High Coordination		
<b>Gender Mix</b>	Male	Female	Mixed			
<b>Gender Segregation</b>	No	Yes				
<b>TEMPORAL ASPECTS</b>						
<b>Flexible Work Hours</b>	No	Yes	Somewhat			
<b>Flexible Work Arrangements</b>	No	Yes	Somewhat			
<b>Formal Break Schedule</b>	No	Yes	Somewhat			

Table 2. Correlation Coefficients Between Work Organizational Factors

	Labor Skill	Social Content	Pacing Determinant	Responsibility for Others	Structural Restraints	Attention Demands	Work Method	Noise
<b>Labor Skill</b>								
<b>Social Content</b>	-0.42 ( $<0.0001$ )							
<b>Pacing Determinant</b>	-0.51 ( $<0.0001$ )	0.62 ( $<0.0001$ )						
<b>Responsible for Safety of Others</b>	-0.41 ( $<0.0001$ )	0.36 ( $<0.0001$ )	0.47 ( $<0.0001$ )					
<b>Structural Restraints</b>	-0.58 ( $<0.0001$ )	-0.42 ( $<0.0001$ )	0.60 ( $<0.0001$ )	0.42 ( $<0.0001$ )				
<b>Attention Demands</b>	0.27 (0.0020)	-0.19 (0.0272)	N/S	0.26 (0.0027)	N/S			
<b>Work Method</b>	0.66 ( $<0.0001$ )	-0.55 ( $<0.0001$ )	-0.62 ( $<0.0001$ )	-0.55 ( $<0.0001$ )	-0.76 ( $<0.0001$ )	N/S		
<b>Noise</b>	-0.28 (0.0015)	0.31 (0.0003)	0.39 ( $<0.0001$ )	0.35 ( $<0.0001$ )	0.50 ( $<0.0001$ )	N/S	-0.44 ( $<0.0001$ )	
<b>Housekeeping</b>	-0.56 ( $<0.0001$ )	0.37 ( $<0.0001$ )	0.49 ( $<0.0001$ )	0.60 ( $<0.0001$ )	0.40 ( $<0.0001$ )	N/S	-0.50 ( $<0.0001$ )	0.44 ( $<0.0001$ )

N/S= not significant

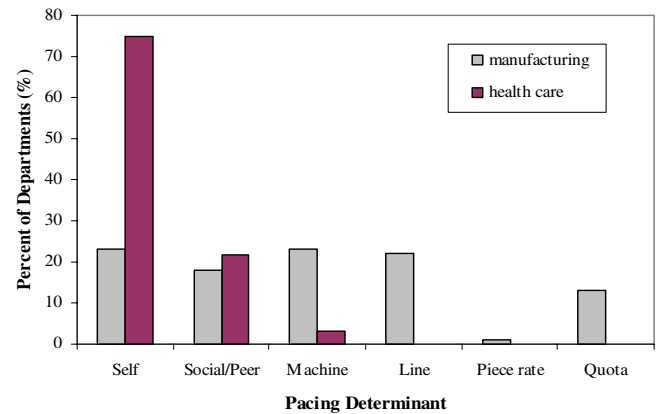
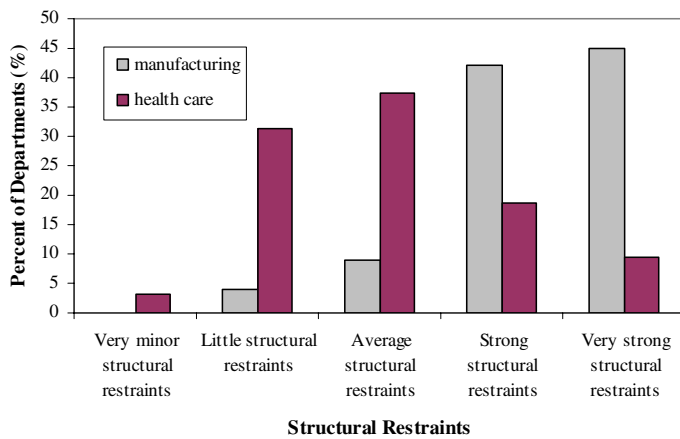


Figure 1. Comparison of Structural Restraints of Task Activities and Pacing Determinants Between Industry Sector.