FINAL PERFORMANCE/PROGRESS REPORT

To: Mary Ann P. Monroe, Acquistion and Assistance Field Branch, PGO

Re: NIOSH Research Grant #5 R01 OH003708-03 entitled WMSD: Evaluating interventions among office workers

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LIST OF ABBREVIATIONS

IWH - Institute for Work & Health

P1 - 1996 workforce wide questionnaire survey as part of the first phase of our collaborative research

Q4 – 2001 workforce wide questionnaire survey, the fourth employee survey during our collaborative research

RSI – repetitive strain injury, the term used by workplace parties for WMSD

SONG – Southern Ontario Newspaper Guild, the union representing office workers

WMSD – work-related musculoskeletal disorders, also known as cumulative trauma disorders and RSI

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ABSTRACT

Goal: To demonstrate the effectiveness of a workplace program for primary, secondary and tertiary prevention of work-related musculoskeletal disorders (WMSD) of the neck and upper extremity.

Aims:
1. To document the nature and timing of the interventions undertaken by the workplace parties (labor and management) as part of their commitment to a multipronged "RSI Program" in an office workplace.
2. To measure changes in awareness of WMSD prevalence, knowledge of WMSD risk factors and management attitudes towards WMSD.
3. To measure changes in exposure to physical and psychological risk factors for WMSD and WMSD symptoms among employees undergoing reorganization and a relative control group to assess the impact of an ergonomically informed reorganization process.
4. To assess whether the RSI Program resulted in a workforce wide reduction in self-reported exposures to physical and psychological risk factors for WMSD with a concomitant reduction in the self-reported period prevalence and severity of WMSD-related symptoms and their associated disability.
5. To implement and evaluate an enhanced workplace WMSD surveillance system.
6. To model changes in rates of health care utilization and associated costs for WMSD and determine whether the RSI Program resulted in reductions in these measures.

Importance to occupational safety & health: Evaluation of workplace ergonomic interventions and longitudinal studies of the impact of work re-organization efforts on musculoskeletal health are sorely needed to inform workplace parties and policy makers.

Approach: A prospective, longitudinal study using mixed methods. Qualitative research based on document review, worksite participation, and interviews was matched with quantitative research using surveys, clinical questionnaires, administrative data bases and intensive exposure assessment methods. Analyses of change used a variety of approaches including trend descriptions, trajectory analyses and path analyses.

Findings:
The workplace parties built on earlier research to develop an innovative Ergonomic Policy. Special RSI/WMSD training sessions were held in all departments, with 58% of 2001 survey (Q4) respondents remembering these sessions and another 11% indicating that they received training on RSI/WMSD as part of their orientation. 90% of Q4 respondents felt that The Toronto Star RSI Program had completely to moderately "ensured that all employees are informed about RSI". Compared to our earlier P1 1996 survey, significantly greater endorsement of relevant responses as to potential causes of RSI/WMSD were observed e.g., workstation, tools, breaks, keyboarding, workload, exercise and posture, at the same time that "lack of training" was mentioned less frequently. Further, 74% agreed or strongly agreed (vs. 64% in 1996) that Toronto Star management were supportive in dealing with RSI though proportions indicating that their

immediate supervisor was aware and concerned about RSI and the proportion of respondents who disagreed that "I can take breaks when I want to" remained unchanged.

Among a small group of predominantly advertising employees undergoing direct measures, we observed reductions in extreme mouse positions (horizontal and vertical), fewer monitors to the side with less head rotation, and fewer extreme head tilts, the last despite monitor heights being generally higher. Increases in keyboard time and post-reorganization mousing time were positively associated with changes in employee pain among those undergoing reorganization into teams. Informal observations suggested that employees' jobs had changed little except for increased use of computers through introduction of new software.

The RSI Program was associated with some positive changes in self-reported exposures to physical and psychological WMSD risk factors. The proportion reporting equipment inside a preferred location increased between P1 in 1996 and Q4 from 56% to 72% for the keyboard as did levels of social support at work. Time sitting >2 hours continuously increased by 9% of P1 to 33% of Q4 respondents. Among a cohort that participated in P1 and Q4 26% got better, 54% stayed the same, and 21% had increased pain. In path analyses on the cohort, RSI training and job task changes were both associated with significant ($p<0.1$) increases in decision latitude and reductions in disability, after taking account of demographic confounders (gender and age).

Over five years, 1000 Ergonomic Reports/Workstation Assessments were completed by over 40 trained assessors, proactively reaching 881 employees as part of an active hazard and symptom surveillance program. The surveillance system met a number of the important criteria for such systems, including utility through a wide range of improvements directly made or planned. Substantial aggregate increases in physiotherapy services promoted by the RSI Program, MSK-related drug utilization and use of NSAIDs occurred through the intervention period. Overall health care costs increased due to a combination of meeting previously unmet needs for physiotherapy and escalating costs associated with changing drug availability and prescribing patterns. At the same time, workers' compensation claim related absence (to 0 new lost time claims in 2001).

Conclusions: Workplace parties, informed by research findings, were able to bring about improvement in a number of physical and psychosocial risk factors, though intense competitive pressures brought about aggravation of some others. Reduction in severity of WMSD and control of WMSD-related compensable absence were both important achievements.

SIGNIFICANT FINDINGS

Through review of documents, participation in RSI Committee meetings we observed the development of an innovative Ergonomic Policy with combined primary, secondary and tertiary prevention components (Aim #1). Special RSI/WMSD training sessions were held in all departments, with 58% of Q4 2001 survey respondents remembering these sessions and another 11% indicating that they received training on RSI/WMSD as part of their orientation. Further, 72% of Q4 respondents with pain reported being engaged in a wide variety of active efforts to respond to pain, including: doing exercises (65%), making posture changes (59%), seeing a health practitioner (57%), reporting their pain to the workplace (40%), educating themselves (38%), and using relaxation techniques (31%).

Interviews and repeat surveys gave us a clear sense of considerable changes in awareness, knowledge and attitudes towards RSI/WMSD during the period of research ((Aim #2). 90% of Q4 2001 survey respondents felt that The Toronto Star RSI Program had completely to moderately "ensured that all employees are informed about RSI". Compared to our earlier P1 1996 survey, significantly greater endorsement of relevant responses as to potential causes of RSI/WMSD were observed e.g., workstation, tools, breaks, keyboarding, workload, exercise and posture, at the same time that "lack of training" was mentioned less frequently. These indicated important changes in knowledge on RSI/WMSD. Further, 85% of Q4 respondents completely to moderately agreed that the RSI Program "promoted continuous improvement in the technology and management practices to control exposure to workplace risk factors that can cause RSI" and 74% agreed or strongly agreed (vs. 64% in 1996) that Toronto Star management were supportive in dealing with RSI. Nevertheless, similar proportions indicated that their immediate supervisor was aware and concerned about RSI and the proportion of respondents who disagreed that "I can take breaks when I want to" was unchanged from 1997 to 2001 (28%). The interviews helped provide explanations where little change occurred. As one manager said, "...productivity is really important here. You have to be always available on your phone. And all their incentives ...[are] based on how much you're producing." Similarly, changes were not as apparent in proactive technology choices and job design as RSI Committee members and we had hoped for due to the limited mandate of the RSI Committee and a range of sectoral, company and departmental level constraints.

We noted some changes in physical and psychological risk factors for WMSD and WMSD symptoms among employees who underwent a move and reorganization process into teams (Aim #3). Among a small group of predominantly advertising employees undergoing direct measures, we observed reductions in extreme mouse positions (horizontal and vertical), fewer monitors to the side with less head rotation, and fewer extreme head tilts, the last despite monitor heights being generally higher. Among the psychosocial factors, fewer task variables changed than expected, though increases in keyboard time and post-reorganization mousing time were positively associated with changes in employee pain. Informal information collected while contacting workers during the intensive exposure and formal interviews with those in teams and not in teams suggested that, in practice, employees' jobs had changed little except for increased use of computers through introduction of new software.

The RSI Program was associated with some positive changes in self-reported exposures to physical and psychological risk factors for WMSD and a concomitant reduction in the self-reported period severity but not prevalence of WMSD-related symptoms (Aim # 4) upon repeat workforce surveys. Participation in these was somewhat reduced due to explicit written consent (versus implied consent) requirements. Overall the proportion reporting equipment inside a preferred location increased between P1 in 1996 and Q4 in 2001 from 56% to 72% for the keyboard and 17% to 61% for the mouse (section G.1). Increased use of computer (27%) and addition of mouse (36%), and increased mean hours of use of keyboard (extra 40 min.) and mouse (extra 56 min.) among users was also reported. Time sitting >2 hours continuously increased by 9% to 33% of 2001 respondents. Improved was social support at work (not RSI related) but unchanged were other risk factors including psychological workload, decision latitude, the extent to which employees' ideas were listened to and the extent of employees' participation in decision making. 68% of 2001 survey respondents reported having pain/other symptoms in the last year, similar to P1 respondents. 40% of these reported their pain to the workplace, particularly if they considered pain a problem or had greater disability and poorer work function scores. Among a cohort that participated in P1 in 1996 and Q4 in 2001 26% got better (13% resolved and 13% less severe/frequent pain), 54% stayed the same (9% still severe and frequent (chronic), 22% still mild, 23% remained symptom free) and 21% had increased pain (5% got worse and 16% had new pain). Overall this meant that more got better than worse, even though those who remained in the cohort were worse at baseline than those that did not continue. In path analyses on the cohort, RSI training and job task changes were both associated with significant ($p<0.1$) increases in decision latitude and reductions in disability, after taking account of demographic confounders (gender and age). Perhaps training gave employees some support to adjust their workload or work rhythm, taking breaks as needed and assuming more control over the process of their work.

Over five years, 1000 Ergonomic Reports/Workstation Assessments were completed by over 40 trained assessors, proactively reaching 881 employees as part of an active hazard and symptom surveillance program (aim #5). The surveillance system met a number of the important criteria for such systems, including utility through a wide range of improvements either directly made, planned or improved as a result of these assessments.

We noted substantial aggregate increases in health care utilization. Increasing privacy concerns mean that access to medical information at an individual level in workplace studies received low endorsement by participants (13%). Physiotherapy services promoted by the RSI Program, MSK-related drug utilization and use of NSAIDs also increased through the intervention period, though we had hoped to demonstrate reductions in costs over time (Aim #6). This was achieved in workers' compensation claim related absence (to 0 new lost time claims in 2001) but nowhere else due to a combination of meeting previously unmet needs for physiotherapy and escalating costs associated with changing drug availability and prescribing patterns.

USEFULNESS OF FINDINGS

The workplace program, structured around a workplace Ergonomic Policy and involving elements of primary, secondary and tertiary prevention of work-related musculoskeletal disorders of the neck and upper extremity, was successful in bringing WMSD under control in a large media company. Workplace parties, informed by research findings, were able to bring about improvement in a number of physical and psychosocial risk factors, though intense competitive pressures brought about aggravation of some others. Reduction in severity of WMSD and control of WMSD-related compensable absence were both important achievements.

Workplace parties generated a variety of creative strategies to "market" RSI/WMSD awareness among company staff, and have received recognition for their efforts within their industrial sector. Labour and management have worked together, using industrial relations tools such as periodic collective bargaining sessions and mandated health and safety representatives to drive implementation of their RSI/WMSD program. The joint RSI committee has continued updating training and ergonomic assessments and worked closely with therapists on site. They recognize the importance of strengthening management practices supportive of dealing with RSI, particularly at the supervisory level. Sustainable change in workplaces dealing with WMSD needs not only commitment and resources but time.

Our experience indicated that less changed in physical and psychosocial risk factors during a much-heralded team re-organization occurred, than was initially hoped for. In keeping with renewed NIOSH emphasis on work organization and WMSD and in the interest of informing public policy and encouraging workplace change which promotes worker musculoskeletal health as well as improved business performance, organizational leaders need to move "upstream" to influence decisions on new technology, organization of work and design of jobs.

1. BACKGROUND

1.1 Importance and Health Relevance

US surveys have shown that 6.7% of the population report shoulder pain, 6.8% finger problems and 4.2% elbow pain. In addition, 12% of people with musculoskeletal disorders of the upper limb had changed their work because of their disorder (Cunningham, 1984). Thirty percent of long term disability in Canada is attributed to its leading cause: musculoskeletal disorders (Badley, 1992). In Ontario, musculoskeletal disorders were second only to heart disease in quantity of prescription drug use and, in the working age group, were the number one reason for consulting a health care professional (Ontario Health Survey analysis, Badley, 1994). Upper limb musculoskeletal disorders, including rotator cuff impairments, carpal tunnel syndrome, tendinitis, and joint arthropathy (i.e., shoulder osteoarthritis), represent a significant proportion of these conditions. Other studies have stated that up to 50% of people with shoulder pain report a reduction in their ability to work (Makela, 1993), conferring a considerable burden to not only the individual, but to society and the workplace.

Work-related Musculoskeletal disorders (WMSD) of the neck and upper limb are second only to low back pain as compensable work-related conditions in Ontario (Beaton, 1995). Their increasing burden is also being noted in the Canadian private insurance sector (Cameron, 1995). As in many US jurisdictions, WMSD of the neck and upper limb are more common in women (Ashbury, 1995). The personal burden of ongoing pain and decreased ability to carried out societal roles has been clearly documented in more severe cases (Himmelstein et al., 1994). Associated costs are high in Canada as in the United States, where NIOSH (1995) has estimated more than $2.1 billion in workers' compensation costs and $90 million in indirect costs (hiring, training, overtime, and administrative costs) are incurred annually for these musculoskeletal disorders. With increasing technological change and organizational restructuring in response to global economic forces, one may be concerned that risk factors for WMSD may increase rather than decrease in the coming years both in manufacturing and office settings.

1.2 Relevant literature

A growing body of evidence implicates both biomechanical and work organizational workplace factors as contributory causes to WMSD in general (Hagberg et al., 1995; Bernard et al., 1997) and among visual display unit office workers in particular (Punnett & Bergqvist, 1997). Although relatively infrequent compared with cross-sectional studies, longitudinal studies of WMSD have contributed important information to our understanding of the course and variability of these conditions and factors which may affect these (Törnqvist et al., 1997). A classic example is a follow-up study of electronics workers through questionnaires and physical examinations (Jonson et al., 1988) which found that those who continued in repetitive assembly jobs showed worsening of symptoms in subsequent years, while those transferred to jobs with more varied tasks showed some improvement in symptoms. Similarly, Bergqvist and colleagues (1995) followed visual display terminal (VDT) workers for seven years and showed changes in levels of symptoms related to particular work changes. Björkstén et al. (1997) followed unskilled female industrial workers and showed that a variety of risk factors changed over time and that, although overall prevalence of neck and shoulder problems declined slightly, levels of pain among a small group of women with more severe symptoms actually increased between surveys.

Systematic evaluations of interventions for WMSD are of limited quality for a number of reasons. Historically, limited attention to design (Kilbom, 1988), inadequate reporting of and analysis for co-interventions (Silverstein, 1987), poor descriptions of populations, exposures and interventions (Cole et al., 1992) and inadequate accounting for the timing or impact of interventions (Buckle, 1997a) have all limited the validity of the available evidence. Workplaces also pose inherent difficulties as field settings suffering their own unexpected changes due to market or business plan changes unforeseen at the time of intervention planning (Westlander et al., 1995). Nevertheless, systematic documentation of both risk factors and symptoms in organizations undergoing change which might affect WMSD have increasingly been both advocated (Silverstein, 1992) and carried out (e.g. Wahlstedt et al., 1997).

Punnett and Bergqvist (1997) summarized literature on intervention studies in VDT workplaces. They concluded that the eight studies identified all supported the role of interventions in reducing upper limb musculoskeletal disorder severity. The interventions included workstation adjustment, education and training, work environment improvement (lighting etc), adjustable furniture and work reorganization either applied singly or in combination. Nevertheless, they raised a number of issues: a) Many studies did not document intermediate variables such as exposure to psychological and physical risk factors. This renders explanation of the mechanism of intervention effect difficult to judge especially as many interventions were applied as a package. b) One study which did measure exposures but did not find a change in symptoms (Aborg et al., 1998) found that the work reorganization intervention resulted in essentially no change in exposure. In contrast Aaras (1997) measured physical exposures pre/post workstation change and found a reduction in both these exposures and shoulder symptoms one year later. c) Training and education were frequently used interventions which usually had multiple goals including enhanced reporting and better workstation adjustment. Yet behaviour and/or the workplace environment change were not guaranteed. In an example from the low back literature, Daltroy et al. (1993) showed that although back school improved knowledge, there was no observable improvement in exposure and work methods. Conversely for WMSD, Montreuil et al. (1997), did observe an improvement in workstation adjustment after training, with parallel change in symptoms among younger workers.

Broader reviews of the effectiveness of occupational health and safety interventions in general (Goldenhar & Shulte, 1994) and ergonomic (Grant et al., 1995), safety and work organization (Polanyi et al., 1998) interventions in particular have each demonstrated the wide diversity in approaches and findings. Similar reviews of cost-effectiveness studies exist for workplace health promotion in general (Pelletier, 1996) and WMSD in particular (Mitchell, 1996). They and more critical pieces have issued calls for improved methodological quality in workplace intervention evaluation studies (Zwerling et al., 1997). Finally, Schulte et al. (1996) argue the need for evaluation teams made up of a range of disciplines which can use a broad spectrum of research strategies to document complex workplace interventions.

1.4 Approach

The study reported here aimed to respond to the identification of an important gap in the availability of research relevant to the implementation of policies (such as the Ergonomic Standard) to reduce WMSD in the workplace. Starting with the nature of the interventions themselves, increasingly multifaceted ones are advocated (including engineering, behavioral and administrative changes) at multiple levels within the organization, in keeping with macro- as well as micro-ergonomic approaches (Hendrick, 1994; Baker et al., 1996). In terms of evaluation design, a number of features have been set out that would improve the validity of evidence for effectiveness: use of qualitative and quantitative techniques in an integrated fashion; use of well-tested instruments for re-assessment of both risk factors (e.g. a set of questions based on the demand-control-support formulation of stressful psychosocial factors) and health outcomes (e.g. NIOSH symptom case definitions); inclusion of measurement of changes in knowledge and attitudes and exposure to both physical and psychological risk factors as intermediate measures (Kilbom, 1988); measurement of changes in risk factors and health outcomes simultaneously; inclusion of outcomes that mean something to workplace parties such as absenteeism and impact on work performance (Pransky & Himmelstein, 1996); extended follow-up of groups of workers over time, limiting the probability of selection biases; and utilization of comparison groups whenever possible to account for other changes in workplaces. Including many of these features of more methodologically rigorous and societally relevant intervention evaluations should provide better evidence for the effectiveness of workplace interventions in the prevention of WMSD-associated disability.

1.5 Project Setting

In early 1995, representatives from the Southern Ontario Newspaper Guild (SONG) approached the Institute for Work & Health (hereafter referred to as the Institute) about WMSD among their members. Soon after, researchers, Guild members, and management from The Toronto Star, one of the largest North American daily newspapers, agreed to engage in a program of collaborative research aimed at reducing the burden of WMSD. Both management and labor were concerned about perceived increases in the severity and prevalence of what they refer to as "repetitive strain injuries" (RSI). While the terms "cumulative trauma disorder" and RSI are in common usage in the general populations, the scientific community prefers the term "work-related musculoskeletal disorder" (WMSD) (Hagberg et al., 1995). Nevertheless, the first two phases of our joint work became known as "RSI Watch".

We deliberately set out to make the project collaborative in nature, addressing both researcher and worksite interests. Research objectives, questions, and study design were determined jointly through the RSI Watch steering committee made up of researchers and equal numbers of management and union representatives. Objectives of our joint work were: a) to identify and examine the interplay between individual, biomechanical and psychosocial factors related to the cause and course of RSIs; b) to determine, and seek evidence for, the effectiveness of current preventive and rehabilitative interventions; c) to recommend organizational, biomechanical and rehabilitative interventions to reduce the impact of RSI's; and d) to evaluate the effectiveness of such interventions. We met objectives a and c and generated preliminary information on objective b prior to the CDC/NIOSH grant. Phase I was a 1996 survey of all office staff at the downtown Toronto head office as well as employees at zone offices and external bureaus including those off work (i.e., maternity and disability leave). Phase II (1997) consisted of a series of in-depth sub-studies which examined risk factors arising out of Phase I. The RSI Watch steering committee used these findings to produce recommendations for interventions. During subsequent contract negotiations, agreement was reached to implement an RSI Program and to have the Institute evaluate its impact during Phase III. Subsequently meetings of an expanded joint labor management "RSI Committee" met to discuss the components of the evaluation proposal that was funded.

B. SPECIFIC AIMS OF THE STUDY

In the interest of informing public policy and encouraging workplace change which promotes worker health, the proposed research had the following long-term objective:

To demonstrate the effectiveness of a workplace program for primary, secondary and tertiary prevention of work-related musculoskeletal disorders of the neck and upper extremity.

Work-related musculoskeletal disorders of the neck and upper extremity or WMSD is an umbrella term for conditions caused or aggravated by work which have been variously described as "cumulative trauma disorders", "repetitive strain injuries or RSI" and occupational overuse syndromes. They remain one of the National Occupational Research Agenda priority conditions.

Within this broad objective were a number of more specific aims which build upon each other in order to demonstrate effectiveness. First, we needed a clear idea of the workplace program itself. Hence the first specific aim:

1. To document the nature and timing of the interventions undertaken by the workplace parties (labor and management) as part of their commitment to a multipronged "RSI Program" in an office workplace.

We proposed to do this through qualitative and quantitative methods in a collaborative research process. We expected the interventions to bring about changes in the organizational culture around WMSD and its expression in knowledge, attitudes and practices within the workplace. This lead to our second specific aim:

2. To measure changes in awareness of WMSD prevalence, knowledge of WMSD risk factors and management attitudes towards WMSD.

During the period of implementation of the RSI Program, a major reorganization initiative took place involving large sections of one department and some employees from other departments. As such, a natural experiment presented itself for determining whether such an organizational change, which incorporated means of preventing WMSD as an application of the RSI Program, could reduce both exposure to risk factors and health outcomes. Such specific intervention evaluation was in keeping with NORA priority area # 5 and led to our third specific aim:

3. To measure changes in exposure to physical and psychological risk factors for WMSD and WMSD symptoms among employees undergoing reorganization and a relative control group to assess the impact of an ergonomically informed reorganization process.

The measurement work was intensive, particularly for the physical measures, precluding its application throughout the organization. However, we had baseline questionnaire information on the vast majority of the workforce permitting assessment of changes in risk factors and symptom severity and duration in the majority of those affected by the RSI program. Hence our fourth specific aim was:

4. To assess whether the RSI Program resulted in a workforce wide reduction in self-reported exposures to physical and psychological risk factors for WMSD with a concomitant reduction in the self-reported period prevalence and severity of WMSD-related symptoms and their associated disability.

One of the ongoing mechanisms proposed to monitor WMSD hazards or risk factors and the incidence of WMSD was an enhanced workplace surveillance system. In order to leave in place such a system after the research was completed, our fifth specific aim was:

5. To implement and evaluate an enhanced workplace WMSD surveillance system.

For many workplaces, monitoring of trends in existing secondary databases which contain crucial cost information is the most important means of evaluation (NORA priority areas 4a&b). We therefore proposed to access a full range of historical and current secondary administrative data on workers' compensation, absenteeism and health care utilization and link it to the primary data collected above. This data collection effort gave rise to our final specific aim:

6. To model changes in rates of sickness absence, rates of health care utilization and associated costs for WMSD, assess whether these measures would be different across organizational units of the company or across groups of employees reporting different levels of risk factors, and determine whether the RSI Program resulted in reductions in these measures over time.

Results relevant to each of these specific aims were meant to respond to our broad objective of demonstrating effectiveness of the multipronged workplace intervention program. The demonstration of effective multifaceted workplace combined prevention and rehabilitation interventions was thought to partially respond to two of the fifteen occupational health and safety objectives for US national health promotion and disease prevention cited in Healthy People 2000.

C. OVERVIEW OF RESEARCH DESIGN

C.1 Program being Evaluated

The 'RSI Program' was a package of interventions introduced to the workplace from under the aegis of a joint labor-management 'RSI Committee' (Cole, Wells et al 2002). Existence of such a consensus-based committee was an indicator of a workplace actively interested in better health and safety performance (Shannon et al., 1996). Given the involvement of the workplace parties in the formulation of research priorities, the leading role in interventions and the interpretation of results, the process could be described as 'action research' (Hugentobler et al., 1992; Schurman, 1996; Polanyi and Cole, 2003).

In keeping with the call for multifaceted interventions with mutually reinforcing components (Stokols et al., 1996), the RSI Program envisaged a variety of initiatives. These included: the development of a company-wide ergonomics policy which details a mission, objectives, responsibilities and evaluation (see appendix I); guidelines for the purchasing or reassignment of workstations and computer equipment; a company wide, comprehensive education and training program; the development of guidelines and recommendations for modifications to the work environment, including changes in engineering, administrative, staffing or work flow practices: ergonomic assessments of all workstations at least every two years; improved reporting processes and on-site physiotherapy services.

The workplace-based RSI Committee was responsible for developing and implementing the components of the program, while the research team members served as consultants to the RSI Committee, providing information on scientific evidence and best practices in each of the relevant areas. For example, when research team members were asked to advise on the objectives and methods of the education and training, they emphasized the importance of participatory adult education methods (Wallerstein and Weinger, 1992) based on concrete problems (Montreuil, 1990) and subsequent feedback to participants on the extent to which they behaved in ways consistent with the training. Collaboration from the beginning of the evaluation work was important (Corbeil & McQueen, 1991).

A particular application of the RSI Committee's work and the research team's expertise was to be advice during a restructuring process agreed to during the last round of bargaining and primarily affecting employees from the Advertising Department. The aim was to create integrated work teams with increased overlap of "non-core job duties" among members of each team. Although the primary purpose of the reorganization was improvement of customer service and productivity, there were a number of mechanisms, enunciated in the labor-management agreement, by which risk factors and severity of WMSD might also be affected: 1) a commitment to improve team work, with increased flexibility around "job borders" and encouraging greater mutual assistance by employees in different job classifications; 2) a similar commitment to income security, on-going training and career development assistance for Advertising department employees; 3) agreement to a process of implementation by a joint union-management committee with decisions by consensus; and 4) explicit requests for input on workstation design and layout from the research team by two members (one labor & one management) of the RSI Committee who were simultaneously on the restructuring implementation committee.

C.2 Research Design Overview

We sought to capture both the breadth of change occurring at the newspaper during the implementation of the RSI Program and focus on certain aspects with particular observational, methodological and analytical tools. We employed a mixed methods longitudinal, evaluation design as set out in Figure 1. Each component included methods and measures to capture both intermediate and longer term outcomes associated with the strategies developed by the workplace parties to control WMSD (table 2 in Cole et al., 2002). From an intervention evaluation perspective, use of multiple methods is required in non-experimental field settings, where potential threats to validity must be matched by careful documentation of interventions, independent ascertainment of exposures and outcomes, and corroborative analytical strategies to assess effectiveness (Goldenhar and Schulte, 1994; Zwerling et al., 1997).

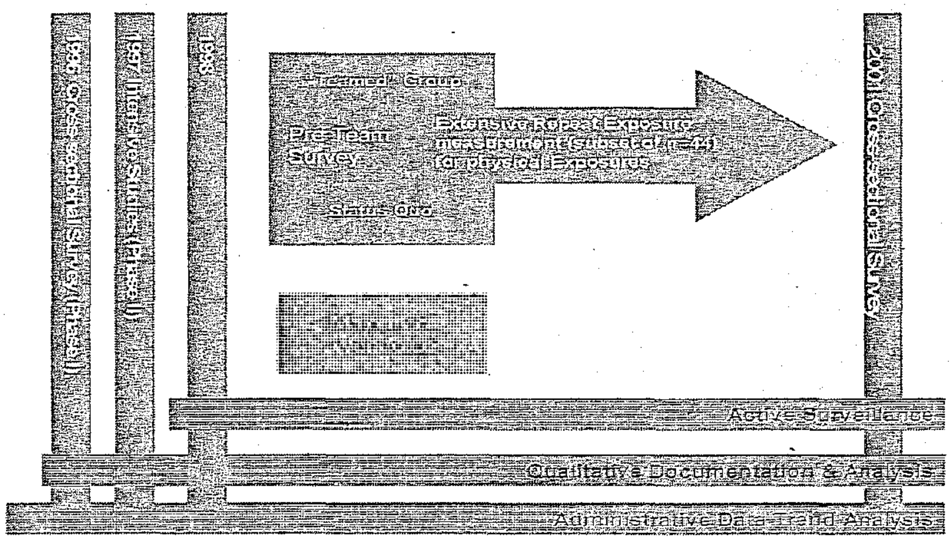


Figure C.1. Overview of research design

For presentation of the different components, we have re-organized the order and grouping from the original proposal to better reflect the way the research unfolded and to more clearly build the argument in this scientific report. Each section includes a brief rationale, followed by the methods, results and discussion.

We start with measure development of both <u>intensive physical exposure measures</u> and work disability (current section D) on subsets of the workforce. The former included task diaries, live observations, video recording, and surface EMG on a selected sample undergoing change (see departmental move and reorganization below). The latter focused on work limitations among employees attending the on-site occupational health unit.

We then turn to active surveillance strategies bolstered in the workplace to better document prevalence of symptoms and risk factors in the workforce and work limitations among those seeking care, over time. The tools included ergonomic assessments of employees and workstations which became part of a computerized data base through which trends in symptoms and risk factors could be analyzed and fed back to the RSI Committee. Similarly, employees attending the on-site occupational health unit or physiotherapy completed standardized pain and health-related quality of life questionnaires over the course of treatment to improve understanding of the clinical course of WMSD in the workplace.

We focused on one departmental initiative as both a physical change, with new workstations, and a work organization change, with new cross-functional teams being formed. We hypothesized that implementation in light of the Ergonomic Policy might result in reduction in WMSD risk factors and improvement of symptoms. A cross-sectional survey of employees undergoing re-organization and job-matched participants from other sections not undergoing the organizational change was conducted just before the change and compared with results in the follow-up survey of the entire workforce (see next section).

This workforce-wide follow-up cross-sectional survey was a key component to permit assessment of changes in self-reported measures of knowledge, WMSD risk factors, symptoms, and disability from before to after RSI Program implementation. Similarly, administrative data trend analysis permitted comparisons of injury incidence, health care utilization, and associated costs across three periods: prior to research activity (1992-1994); during etiological research activity (1995-1997); and during the RSI Program implementation phase (1998-2000). Finally, qualitative documentation and analysis sought to document participants' experiences of workplace organizational changes and clarify the nature of RSI Program interventions. Participation in joint labor-management RSI Committee meetings, solicitation and review of key documents, key informant interviews, and individual participant interviews were used to better understand implementation, note unintended program effects and interpret the quantitative results.

Following reports on each component, cross component synthesis of results and reflection on their contributions to the aims of the research are carried out in the conclusions section of the report.

D.1 Intensive Exposure Assessment

D.1.1 Rationale

Exposures relevant to WMSD in office-based work settings (and others) have not been consistently defined (Wells et al, in press). Many factors can be considered "risks" as Figure 1 shows. The type of job that a worker performs is a potential risk factor. A particular job involves a number of tasks as well as amounts of time spent doing each task throughout the workday. There are a number of ways to record the tasks that workers perform but the relationship between different methods of task observation or recording has not been well studied. Different task data could potentially lead to conflicting advice for improvements to work situations. Another set of risk factors arise from physical attributes of the office environment that can also be quantified. These include the workstation dimensions and the worker's relationship to the workstation (postures). Recently Gerr et al (2002) suggested that there are relationships between certain workstation/posture combinations and work-relevant musculoskeletal disorders.

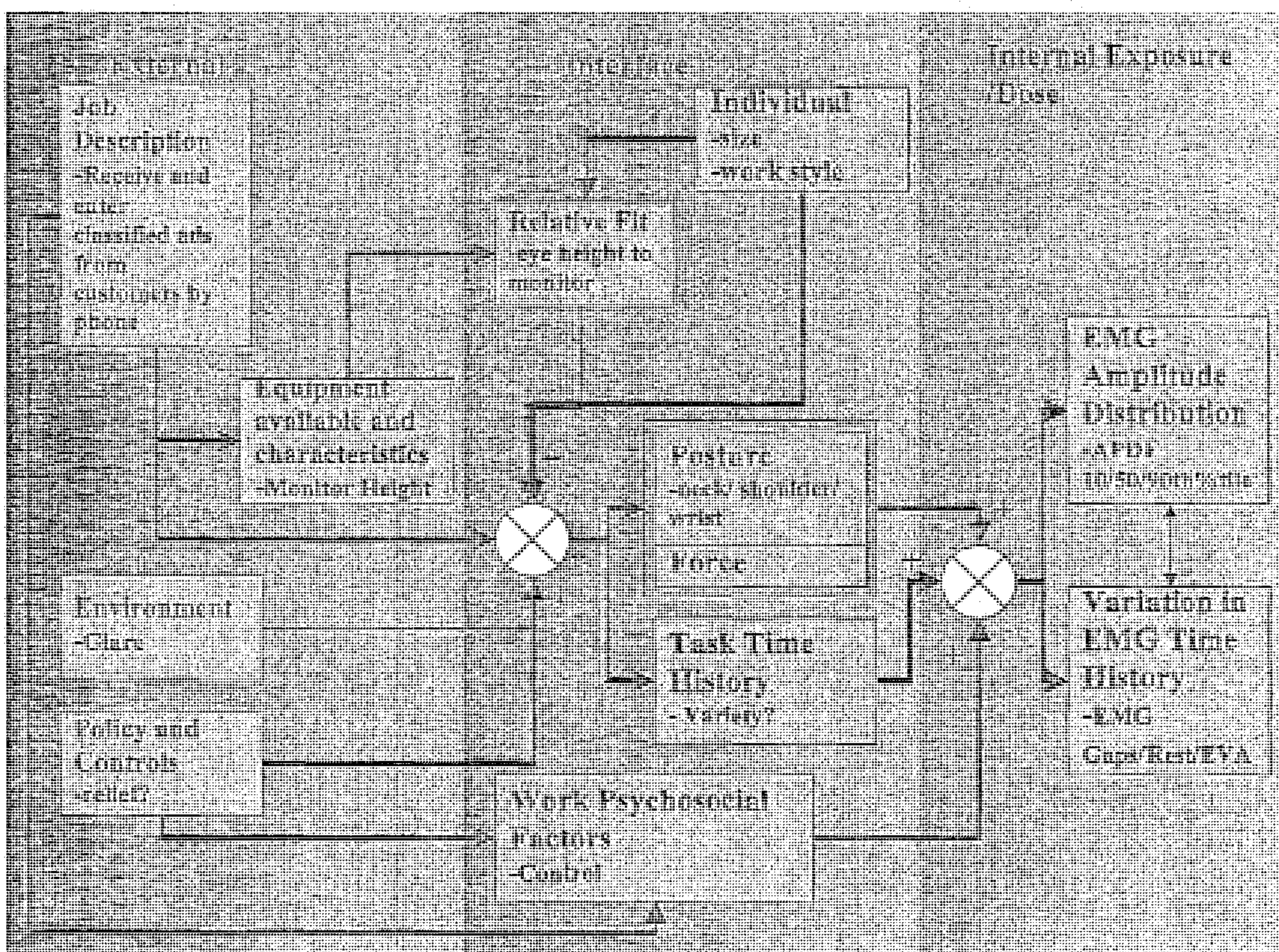


Figure D.1.1: Proposed exposure model for an office environment

The objective of this study component was to take intensive measures of potential exposures and compare these methods. To this end we recorded and examined the relationship between various task recording methods (task diary, direct observation, and video recording). We also examined the relationships between measures of workstation-worker interaction and electromyographical (EMG) signals of the shoulder and forearm muscles for different tasks.

D.1.2 Population

To obtain representation of jobs entering teams we asked 88 employees to complete daily task diaries, of whom 66 agreed. Of the 66 (¾) diary volunteers, 45 (about 2/3) volunteered for the full EMG protocol at baseline. Drops in participation mostly stemmed from the respondent burden involved.
Of the 44 workers who volunteered for the EMG protocol, 41 participated in the 2000 study: (71% female), they had a mean age of 41 years (sd=9.6), a mean height of 168cm (sd=10.3), and a mean weight of 74kg (sd=19). The workers were from advertising, circulation and finance departments doing clerical, administration, sales, customer accounts and call centre jobs.

D.1.3 Data Collection

Data were collected in 1999, 2000 and 2001. The 2000 data collection (which took place between May and September) was most comprehensive across all measurement techniques. To date, analysis has concentrated on these 2000 data. Longitudinal analysis to evaluate change over time is planned.

Questionnaire

A questionnaire was administered which covered a range of information encompassing demographic factors, workstation setup, and the nature of employee's work. Of particular interest here are the following: amount of time spent keyboarding, mousing, sitting and on phone; aspects of workstation setup such as optimal placement of keyboard, mouse and monitor; and availability of equipment such as arm rest, phone headset and document holder.

Task descriptions

Task diary: Workers were asked to complete a task diary detailing the tasks that they completed during a work day. The task diary used a consistent set of 21 codes derived after consultation with workplace parties. These codes represented tasks that were considered common to office settings (eg. keyboarding, mousing, phone, deskwork etc). The worker could add to this set of codes if s/he felt that s/he performed tasks not represented by existing codes or combination of codes. The workers were asked to write down a code or combination of codes that represented the tasks that they completed in each 15 minute block of time for three consecutive (8 hour) workdays. The workers were further instructed to indicate sequential tasks in a 15 minute block using commas to separate each task and to indicate concurrent tasks with a plus sign between each task code. It was felt that this would accurately represent the possible tasks and task combinations that occur in a typical workday. The task diaries were completed within one week of direct observation and were to include the same day of the week as that observation. Measures were created as follows: total time spent and percent (%) time doing each unique task, number of tasks performed in a given day and number and rate of task transitions.

Direct observation: Each worker was observed at her/his own workstation for a two hour period by a trained observer using the same set of codes used for the task diaries. The observers could add codes as necessary to reflect new tasks. The observers recorded tasks performed by the workers in one minute blocks of time, using commas to indicate sequential tasks and a plus sign to indicate concurrent tasks. The direct observation was done concurrently with a video recording and the EMG data collection. As well workstation dimensions and worker postures were taken during the two hour observation period. As per the task diaries, measures were created as follows: total time and percent (%) time in each task, number of tasks and number and rate of task transitions during observation period.

Video: A VHS video recording was taken of the worker at her/his own workstation for two hours. The video camera was focused on the worker and as much of her/his workstation as space allowed. The video recording included the keyboard, mouse, monitor and as much desk space as possible for each worker and was only limited by the space and opportunities for camera placement. There was no sound recording taken with the video. The video recording was done concurrently with the direct observation, the EMG data collection, work station dimensions and worker posture measurements. A half hour portion of the video recording was later observed and used for two purposes: (1) to "chunk" the parallel EMG recordings (described next); and (2) to create measures of the number of unique tasks, the time spent doing those tasks, and the rate of task transitions. The portion was chosen to have the worker at their workstation as much as possible while also including synchronization points with the EMG.

Physical environment

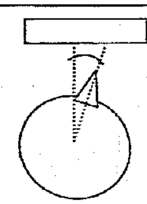
Workstation dimensions: Dimensions of the workstation were taken by trained observers while the worker was present at the workstation. Measures were taken consistently across various workstations (see Table D.1.1). The orientation of workstation equipment was determined relative to the J key of the keyboard. A calibrated "bubble" level was used as a reference as needed. It is estimated that the workstation dimensions were accurate to within 5 mm.

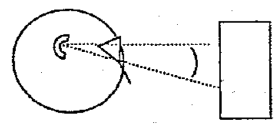
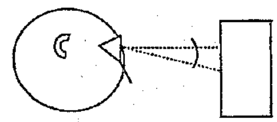
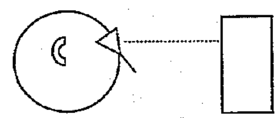
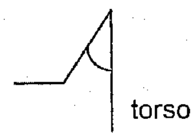
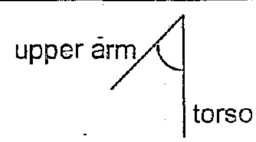
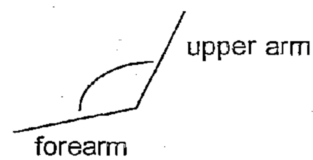
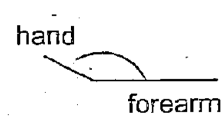
Table D.1.1 Examples of workstation dimension measurements

Workstation Dimension	Measurement
Keyboard Height	from floor to the height of the J key
Keyboard Width	from J key to left edge + J key to right edge
Keyboard Depth	from the table/desk edge to the front edge of the keyboard
Mouse Height	from floor to the height of the mouse pad/surface
Mouse Orientation	from the J key to the centre of the mouse pad/surface
Mouse Depth	from the table/desk edge to the center of the mouse pad/surface
Monitor Size	diagonal measure from screen edge to screen edge
Monitor Height	from floor to top of screen
Monitor Orientation	from J key to centre of screen
Monitor Depth	from table/desk edge to centre of screen
Monitor Tilt Angle	number of degrees from perpendicular (-ve = facing downward)
Seatpan Height	from floor to top surface of seatpan
Seatpan Depth	from the lumbar support area of backrest to front of seatpan
Armrest Height	from floor to top surface of armrest
Armrest Width	from inside edge of one armrest to the inside edge of the other

Working postures: Worker postures were measured while they were at there workstations engaged in typical work situations. Postures were measured with hand-held goniometers using standard anatomical landmarks and body segments by trained observers. A calibrated "bubble" level was used to provide a reference for these measures. It is estimated that all posture measures were taken to within one to two degrees of accuracy. Subject heights were taken from self-reported questionnaire responses.

Table D.1.2. Examples of workstation posture measurements

Workstation Posture	Measurement (all taken while worker was working)	Diagrams
Head Rotation	Viewed from above the worker: angle between a line perpendicular from the centre of the monitor and a line from the worker's nose	

Head Tilt Angle	Viewed from the side: angle between a line parallel to the floor from the worker's ear to the monitor and a line from the worker's ear through the eye	
Gaze Angle	Viewed from the side: angle between a line from the worker's eyes parallel to the floor and a line from the worker's eyes to the middle of the screen of the monitor	
Viewing Distance	Viewed from the side: distance from the worker's eyes to the centre of the screen (note this could be considered a dimension but is included here because it includes the worker and the equipment)	
Shoulder Extension	Viewed from the side: angle between upper arm and torso	
Shoulder Abduction	Viewed from behind: angle between upper arm and torso	
Inner Elbow Angle	Viewed from the side: angle between the upper arm and the forearm	
Wrist Extension	Viewed from the side: angle between the dorsal surface of the hand and a line extending from the ulna	
Wrist Ulnar Deviation	Viewed from above: angle created from a line in the center of the dorsal hand and a line extending from the center of the dorsal forearm (between the ulna and radius)	

Electromyography: Electromyographic signals were recorded bilaterally from Extensor Carpi Radialis Brevis (ECRB) and trapezius on two different days for a two hour period each day. Workers worked at their regular jobs at their assigned workstations. The EMG was recorded simultaneously with the videotape. Root Mean Square (RMS) EMG was collected at 10 Hz using a commercially available portable system (ME3000P8, MEGA electronics, Finland, CMRR 110 dB, 15-500

Hz). EMG was collected using silver/silver-chloride disposable electrodes at a 2 cm spacing. For ECRB, the electrodes were placed one third of the distance from the lateral epicondyle to the radial styloid. For trapezius, the electrodes were placed midway between C7 and the Acromion. The EMG was started in the view of the camera and was later marked using a switch provided with the equipment in the view of the camera to allow for synchronization of the EMG and video. EMG measures were calibrated both to Maximum Voluntary Contraction (MVC)and to Relative Voluntary Exertion (RVE). For trapezius, MVC was achieved by having the participants pull maximally against straps that were fixed to the floor and looped over their elbows while they stood with both shoulders abducted 90 degrees. For the RVE, the participants held fixed weights (2 Kg) in both hands in the same posture. For the ECRB, MVC was recorded while the participants simultaneously performed a maximal grasp while extending their wrist. For the RVE they supported a 5 Kg load hung by a strap over the MCP joints. Hook up and calibration occurred prior to returning to the participants' workstation in a dedicated office away from their work area. Tests were also performed to confirm signal quality and quiet level.

D.1.4 Procedures and Analyses

Task Description

The workers indicated on the questionnaire the length of time they spent doing keyboarding, mousing or phone tasks in a 'normal' eight hour day. In addition to the questionnaire, the nature and number of tasks completed by the workers during their normal work were recorded using task diaries (self report), direct observation, and video recording. Each of these methods used a common set of task codes to represent the tasks that the workers completed during a typical work day. The direct observation and video recording were done on the same day and the task diary was completed one week later encompassing the same day of the week as the other observation methods. The recording time blocks differed between methods: the task diary required recording of the tasks performed each 15 minutes, the direct observation method required an observer to identify and record the tasks performed by a worker each minute, and the video method allowed the analyst to slow down or rewind the video tape to estimate the task start and end times to the nearest tenth of a second (Observer Pro 4.0, Noldus Information Technology, Netherlands). The video data was coded by a trained analyst who captured the start and stop times for a subset of the 21 codes used for the task diaries and the direct observation. These task codes included keyboarding, mousing and phone tasks.

Task codes from the various methods were entered into spreadsheets for further manipulation. SAS (SAS Institute Inc., 1989) was used to create datasets and calculate the measures used for analysis (see Table D.1.3). The task data from all methods were tabulated to examine the number of tasks, rate of task transitions and the percent of time spent keyboarding, mousing, and on phone. These three tasks were chosen because they were identified as important tasks in an office environment. Pearson correlations were calculated between each of these measures for each pair of observation methods.

Table D.1.3. Task description measures

Method	Self, Report	Diary	Live Observer	Video Analysis
Overall Time	n/a	Time on task	Time on task	Time on task
Overall Task Transitions	n/a	# of transitions	# of transitions	# of transitions
Task: Keyboard, Mouse, Phone**	%time (8 hour day)	%time over 3 days	%time in 2 hours	%time in 30 minutes*

* 30 minutes of the video tape was analyzed
**phone only included handset use from the video analysis

Physical Exposure Assessment

The questionnaire administered posed questions about the setup of the workstations. This information was used to compare the differences in dimension, posture and EMG measures between those who reported having their equipment in an optimal position versus those who did not. Measurement of workstation dimensions, worker postures, and a video recording of the worker were done concurrently with the EMG collection. The EMG signal was analyzed using two methods commonly used for workplace analysis: APDF-Amplitude Probability Distribution Function (Jonsson, 1982) and a Gaps Analysis (Veiersted et al, 1990).. The APDF allows for a cumulative summary of all the EMG levels used throughout a specified time period, and is usually summarized using three points – the static level (10^{th} %ile), the median level (50^{th} %ile) and the peak level (90^{th} %ile). The gap analysis calculates the portion of the period of interest in which the muscle gets to "shut off" or rest for at least 0.2 of a second. The periods of interest consisted of the EMG corresponding to the performance of a specific task or groups of tasks. This was achieved using custom software which linked the video analysis with the EMG recordings in time. Once linked, all samples of EMG corresponding to a particular task were concatenated together (Moore et al, 2003a).

The ability of such an approach to differentiate between tasks in an office setting even when these tasks are done within an environment of other tasks that may or may not be done simultaneously was tested by using a generalized linear model (SAS) with the EMG output measure as the dependent variables and the on/off state of a task, subject and day as independent variables. Further, the relationship between task performed and physical exposure was assessed by comparing the EMG levels across different tasks as performed on their own and specific combinations of tasks.

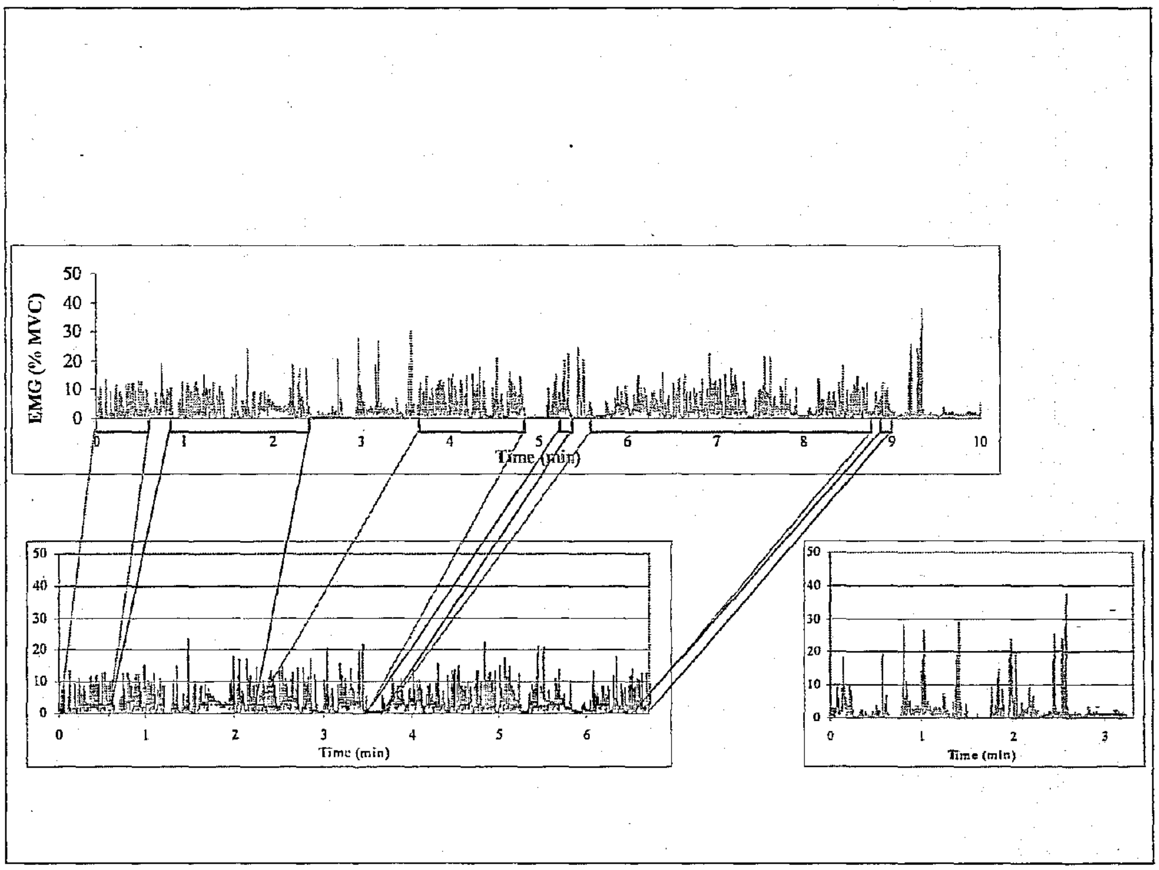


Figure D.1.2. Graphical depiction of EMG "chunking" method

To determine possible predictors of physical exposure (work environment variables which likely determine the loads on the musculoskeletal system), a series of preliminary analysis steps were implemented. The following measures were considered as possible predictors and summary statistics were computed using SAS.

A) Daily workstation task time with respect to equipment use (keyboard, mouse, sitting and various support systems), and telephone use (the multitude of types of phones – headset/handset). Information was collected from the questionnaire on these measures.

B) Upper limb support through use of tables/rests during upper limb work to relieve neck/shoulder load. This information was taken from the questionnaire and dimension measures.

C) Workstation Equipment Characteristics: Presence or absence of specific equipment and characteristics. Keyboard, mouse, telephone(headset), chair(adjustable height, backrest, arms), forearm/wrist support, document holder. Information on these measures were collected both through the questionnaire as well as the dimension data collection process.

D) Workstation dimensions(linear): Absolute height of keyboard, mouse, monitor, table, elbow, eye.

E) Postural information (angles): Wrist shoulder and neck when using the main input devices. This will include gaze angle, relative monitor height, neck rotation and flexion, shoulder abduction, wrist extension and ulnar deviation.

The table below summarizes many of these variables and provides a comparative representation of the methods and measures that were used for the statistical analysis.

Table D.1.4 Exposure Methods: Self report, Posture, Dimensions and EMG Measures

Measure	Method			
	Self, Report	Dimensions*	Posture**	EMG***
Equipment	Chair Arm Rest	Arm rest	n/a	Sitting: Left + Right trapezius
	Phone Headset or Hand	Phone variables	n/a	Using Phone: Left + Right trapezius
	Wrist Rest (keyboard)	Key support	n/a	Using Keyboard: all muscles
	Wrist Rest (mouse)	Mouse wrist rest	n/a	Using Mouse: all muscles
Relative Fit Mouse	Position of Mouse: Optimal vs. Non-optimal	• Mouse height - seatpan height • Mouse fore/aft • Mouse side to side	n/a	Using Mouse based on height: R trapezius Using Mouse based on fore/aft: R trapezius Using Mouse based on side to side: all R muscles
Relative Fit Monitor	Position of Monitor: Optimal vs. Non-optimal	• Monitor height - seatpan height • Monitor-fore/aft • Monitor-side-side	Head tilt angle Gaze angle Viewing distance Head rotation	Using Keyboard or mouse: R + L trapezius

Measure	Method			
	Self, Report	Dimensions*	Posture**	EMG***
Relative Fit Keyboard	Position of Keyboard: Optimal vs. Non-optimal	• Keyboard height - seatpan height • Keyboard-fore/aft • Keyboard-side to side	Elbow angle Shoulder Extension Shoulder Abduction Wrist Extension Wrist Ulnar Deviation	Using Keyboard with shoulder measures: all muscles Using Keyboard with wrist measures: all muscles

* The dimensions measures for mouse, monitor and keyboard were analyzed a second way by dividing all dimensions by worker height.
** The postures measures were analyzed a second way by dividing those in optimal vs those on non-optimal postural ranges.
***EMG measures include: Static (APDF 10%), Dynamic (APDF50%), Peak (APDF90%), Gaptime

Scatterplots were created to describe the relationship between continuous measures and box plots were used to illustrate the distribution of EMG measures based on workers' responses about their workstation setup. Similarly, summary statistics were calculated on workstation dimensions and posture measurements and stratified by workers' responses about optimal workstation positions. Simple linear regression methods were employed to determine the relationship between these EMG measures and the workstation-worker interface for each task. All analyses were completed using SAS and S-plus.

D.1.5 Preliminary Results and Discussion

Task Description

Of the 41 workers who completed a questionnaire, 34 completed a task diary; therefore, questionnaire, task diary and direct observation results were calculated for these 34 workers. Of these 34 workers there was video data available for 23. The first thing to note about the various task reporting/observation methods is the differing length of time periods each encompasses (Table D.5). The questionnaire and task diary, or self report methods, cover the entire work day. The direct observation examines approximately two hours and the video covers 30 minutes of the work day. Despite this decrease in the amount of time observed across the methods, the number of tasks recorded in the observation period is similar (actually increases slightly). However the number of task transitions increases greatly as the recording time block decreases for each method. The questionnaire based estimates of percent time performing these tasks are consistently higher than estimates from the other methods. The task diary, direct observation and video give similar average group results for percent time spent keyboarding. Estimates of percent time mousing are lowest from the task diary and direct observation while estimates of percent time on phone are lowest from the video.

Table D.1.5. Means (and standard deviation) of time of observation, number of tasks, number of task transitions, % time keyboarding, % time mousing and % time on phone for questionnaire, task diary, direct observation, and video methods of recording tasks.

	Observation/reporting method			
Measures	**Questionnaire** N=34	**Task Diary** N=34	**Direct Observation*** N=34	**Video*** N=23
Total time (minutes)	480	470.3 (82.1)	112.2 (12.8)	30.7 (3.8)
Recording time block	Full day	15 minutes	1 minute	1/10 minute
Estimated # of tasks in observation period	n/a	4.8 (1.1)	5.6 (0.8)	5.9 (1.1)
Estimated # of task transitions per hour	n/a	6.0 (4.8)	34.3 (15.6)	254.2 (80.9)
Estimated % time keyboarding	40 (28)	23 (19)	26 (22)	27 (22)
Estimated % time mousing	30 (26)	6 (13)	9 (12)	17 (20)
Estimated % time on phone	35 (29)	18 (21)	17 (19)	11 (16)**

* The video was a subset of the time that the direct observation occurred. The video was not useable for all subjects.

** Note: The definition of "on phone" differed slightly for the video method as a handset had to be observed. This likely underestimates the mean percent time because time on phone using a headset is not included in the measure.

The Pearson correlations between the task diary, direct observation and video methods of collecting percent time on task for the tasks of keyboarding, mousing and phone varied between: -0.15 and 0.69 (see Table D.1.6).

Table D.1.6: Pearson correlation for percent time on task for keyboarding, mousing and deskwork, comparing various task observation methods: Task diaries (TD), Direct observation (DO) and Video (VD).

Task	TD v DO	TD v VD	DO v VD
Keyboarding	0.52	0.44	0.69
Mousing	0.34	-0.15	0.46

Deskwork	0.29	0.01	0.16

The various methods of gathering data about the tasks that workers perform during the work day provide different estimates of task length and task transitions. One reason for the differences in the estimates may be the varying recording time blocks for each of the methods. However, the estimates of time spent keyboarding are very similar across methods, although correlations between these are typically moderate indicating some lack of agreement for individuals.

These different methods of recording tasks also vary in how much they cost to implement in a workplace study. Deciding on the best method for a particular workplace study will depend on precision requirements and the costs of the methods.

Task specific EMG

Comparisons between the EMG measures for performing a task and not performing a task found key significant differences. A significant increase in the 10^{th} percentile static EMG level was recorded for time spent keying versus not keying for all muscles recorded (Figure D.1.3). The gap time decreased significantly for both ECRBs. These results suggest that there is a measureable difference in the EMG levels between performing keying and the performance of other tasks within the workplace. The performance of keying was found to have high static loads and reduced gaptime indicating a reduced availability in muscle rest particularly in the forearm extensors.

An increase in static EMG was also found for time spent using a mouse compared to not using a mouse, however that effect was most pronounced in the Right ECRB (Figure D.1.4). It should be noted that all participants used their mouse on the right side. Peak EMG showed a significant decrease with mousing for most muscles (Figure D.1.4). Combined with the results from the static analysis, these results suggest that mousing is associated with decreased resting time yet reduced peaks indicating a more constrained movement. It is important to remember that not mousing may indicate a range of office tasks at or away from the desk including tasks such as reaching that may require higher peak levels.

Combining video and EMG over long term recordings in the workplace allows for differentiation of the muscle loading by task even within the context of the workplace where tasks may occur simultaneously and may switch frequently.

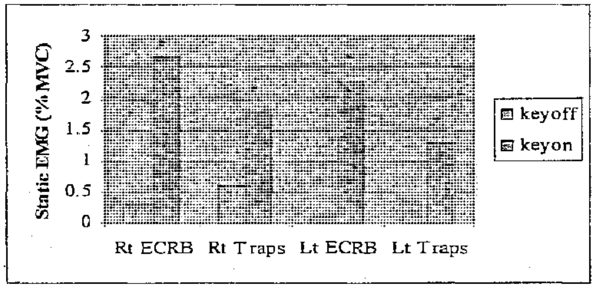


Figure D.1.3 Static EMG for Keying vs Not Keying

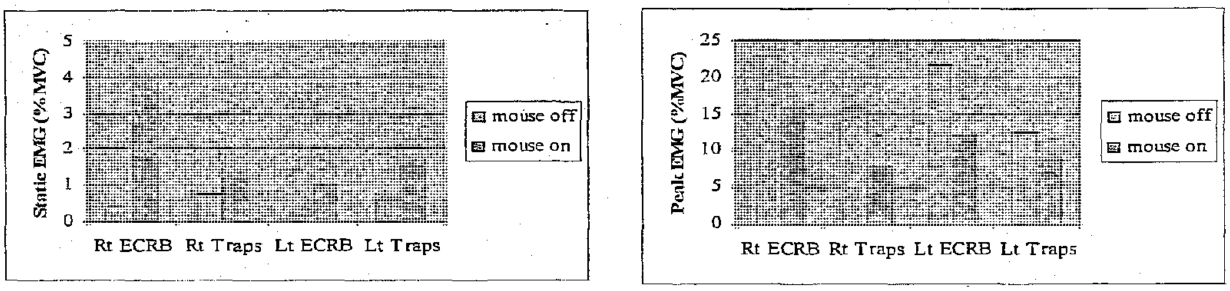


Figure D.1.4 Static and Peak EMG associated with Mousing

Exposure Measurements

Comparisons across all physical exposure methods were assessed with worker's report on availability and use of support systems and the positioning of such equipment. In reference to Table D.1.4, a cross-validation assessment of worker's report and dimension measures taken of the availability of support systems showed high agreement. A stratification of the dimension measures based on optimal and non-optimal position of workstation equipments, i.e. mouse, keyboard and monitor, revealed no differences in the distributions. The table below presents the distribution of the various dimension measures taken with regards to the use of a keyboard and shows that there are no significant differences between these distributions with respect to the report of the position of the keyboard. Notably out of the 41 people, 27 reported having a keyboard in an optimal position while 14 reported having a keyboard in a non-optimal position.

Table D.1.7: Means (SD) of dimension measures for self-reported optimal and non-optimal keyboard positions

		Reported position of keyboard from questionnaire	
Measure	**Keyboard Variable**	**Optimal**	Non-optimal
Dimensions (cm)	Height from seatpan	22.78 (5.0)	23.9 (5.5)

	Fore/aft distance	5.1 (5.0)	4.6 (6.3)
	Side to side – monitor*	4.2 (4.8)	5.6 (4.6)

* Keyboard side to side is measured relative to monitor position.

This lack of difference in distributions between optimal versus non-optimal reports of the equipment was also seen when comparing the self report with postures. Similarly, the table below summarizes the descriptive statistics for both the left and right posture measures based on the use of a keyboard. It should be noted that the posture measurements for one of the 14 people who reported having a keyboard in a non-optimal position was unavailable. Thus, the results below are based on 27 people who reported having a keyboard in an optimal position and 13 people who reported having a keyboard in a non-optimal position.

Table D.1.8: Means (SD) of posture measures for self-reported optimal and non-optimal keyboard positions

		Reported position of keyboard from questionnaire			
Measure	**Keyboard Variable**	**Optimal**		**Non-optimal**	
		Right	Left	Right	Left
Postures (degrees)	Shoulder extension	19.1 (10.2)	18.4 (10.5)	21.9 (19.6)	31.2 (13.1)
	Shoulder abduction	19.7 (12.2)	16.8 (10.9)	16.0 (10.6)	16.0 (7.9)
	Elbow angle	109.1 (15.6)	108.5 (13.6)	112.0 (15.3)	114.7 (13.3)
	Wrist extension	17.0 (9.4)	15.2 (9.7)	18.2 (21.3)	18.5 (12.7)
	Wrist ulnar deviation	7.8 (4.0)	10.1 (7.3)	8.9 (8.4)	7.8 (3.4)

Similar to the analysis described above, little relationship was found between dimensions and postures as well as dimensions and EMG and postures and EMG. Scatter plots of dimension variables with posture variables revealed virtually no relationship. Scatter plots of dimension measures and EMG measures also demonstrated a lack of discernable relationship, linear or otherwise. And there was no distinction between those who reported having equipment in an optimal position versus those who did not. Thus, there were no differences found in the means comparing workstation dimensions with inside/outside the box (optimal/non-optimal position) and posture measures with inside/outside the box. Similarly, visual analysis of the scatter plots of workstation dimension and posture measurements versus EMG measures revealed no systematic relationships.

Of the 41 people, there were only 33 workers with complete data; that is, those who had completed a questionnaire, and on whom dimension, posture and EMG measures were taken. Eleven of these workers indicated that their keyboard was in a non-optimal position while 14 reported that their mouse was in a non-optimal position. Box plots of the static (APDF10) and peak (APDF90) EMG measures for the task of keyboarding showed similar distributions for both non-optimal and optimal positions; however, the dynamic (APDF50) EMG measures showed greater variability for those worker's who reported that their keyboard was in a non-optimal position. Findings also showed that workers reporting optimal keyboard positions demonstrated longer gaptimes across all muscles (Figure 1). Box plots (Figure 2) of the mousing data illustrate that the EMG measures of the right ECRB tended to be higher for those with a non-optimal mouse position versus those indicating an optimal position.

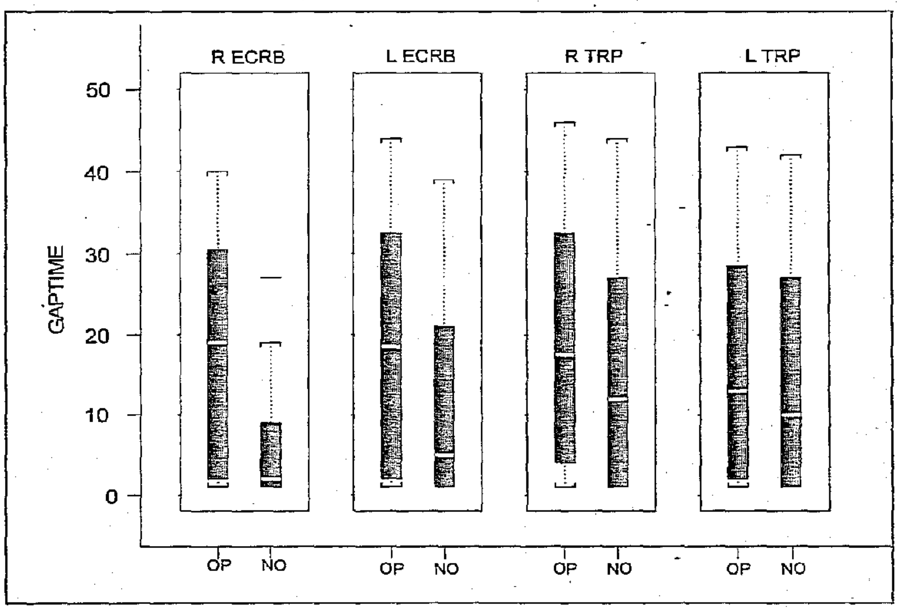


Figure D.1.5: Distribution of gaptime across all muscles for optimal keyboard position (OP) versus non-optimal keyboard position (NO) while keyboarding.

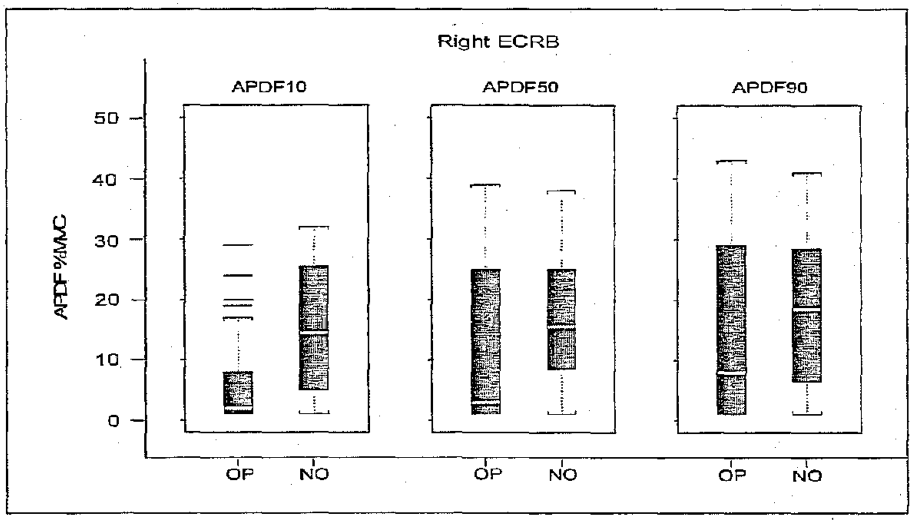


Figure D.1.6: Distribution of 10th, 50th, and 90th percentile EMG levels from the APDF from the right ECRB for optimal mouse position (OP) versus non-optimal mouse position (NO) while mousing.

Consistent with our hypothesis, workers who reported using wrist or elbow support (in mousing) demonstrated longer gaptimes indicating greater rest of the muscles involved. Support devices such as wrist rests were considered in combination with optimal/non-optimal placement of the keyboard and mouse (see Figure D.5). For mousing, the best scenario with respect to gaptime was a combination of optimal mouse placement and wrist rest use. However, it should be noted that these findings were not necessarily as telling for the keyboard. It appeared that some EMG measures were sensitive to the positioning of the keyboard or mouse, while some more sensitive to the use of a support device. Our hypotheses were not clearly supported by all of the EMG measures.

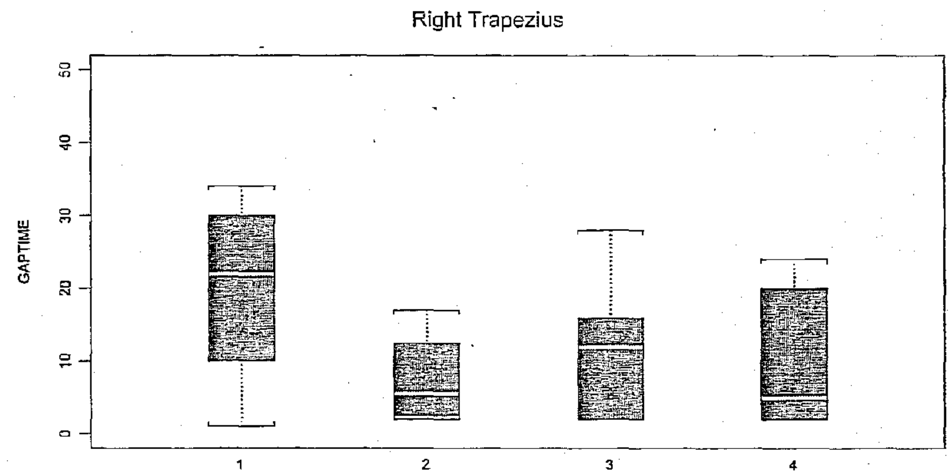


Figure D.1.7: Distribution of gaptime for the right trapezius muscle for (1) optimal mouse position with mouse support; (2) optimal mouse position without mouse support; (3) non-optimal position with mouse support; and (4) non-optimal position without mouse support.

The results indicate that levels of musculoskeletal loading vary according to a worker's report of her/his workstation equipment being in an optimal position. There are a number of EMG measures that showed differences between workers reporting optimal and non-optimal workstation positions. Comparisons of direct workstation dimension measurements and posture measurements do not show strong or consistent relationships with the EMG measures collected. This may be attributed to the great variability possible in workstation dimensions and worker postures within optimal equipment positioning which may be related to other factors such as worker size. Worker reports about optimal versus non-optimal mouse placement do correlate with elevated muscle loading in the right ECRB. Worker's reports of their workstation setup do seem to provide some information in this regard.

D.1.6 Planned Directions

A pattern recognition (discrimination) method of EMG signals will be used to distinguish between forearm muscle activation in optimal and non-optimal positions and to estimate the dynamic structure of EMG data from a sequence of work tasks. The method uses hidden Markov models to illustrate state (task) transitions.

The comparison of physical exposure methods is based on the underlying assumption that each measure is accurately measuring the concept of exposure. Different levels of measurement error can lead to uncertainty in linking the various measures. Further uncertainty in linking may result from measures that were taken at different times. Rescaling the measures to form an equilateral assessment results in two sources of error - measurement error and linking error. Linking error will be quantified using equipercentile equating methods. The total error variance of the group will also include quantification of sampling error.

The main remaining analyses to complete will be those which focus on the longitudinal aspect of the data, looking for changes over time, in particular, changes from pre- to post-reorganization (see section F2).

This section (D.1) is comprised of information from the following papers: Van Eerd et al (2003a), Van Eerd et al (2003b), Mazumder et al (2003a), Mazumder et al (2003b) Moore et al (2003a) and Moore et al (2003b).

D.2 Work Limitations Measurement

Measures of a patient's perception of the level of difficulty that they are having at their job are scarce. The 16-item Work Limitations Questionnaire (WLQ-16) is one such instrument. The purpose of this component was to evaluate the psychometric properties of the WLQ-16 in a group of 42 workers reporting to occupational health with upper limb or low back pain, but not taking time off work.

Detailed information on this component is contained in the appended IWH working paper "Beyond return to work; Testing an outcome measure of at-work disability." In brief, data were gathered over a 12-week period using a questionnaire package (Appendix IV) in the "Treatment Monitoring" component of the study (see section E.2). Psychometric testing (distributions, Cronbach's alpha, construct validity and responsiveness to change in problem and pain) was done using the baseline and 12-week data.

The WLQ-16 had evidence of construct validity, internal consistency and responsiveness. Some ceiling effect was found in the domains of mental-interpersonal and output demands. Physical demands suffered from missing values in 18/42 due to not-applicable content. Construct validity revealed that there was less discrimination at the higher (less limited) end of the scale.

Responsiveness was present, though often less than found with other measures of function and pain. The WLQ-16 shows promise as a measure of at-work disability. Further testing to evaluate the ceiling effect and responsiveness to more congruent constructs of change is recommended.

E. ACTIVE SURVEILLANCE

Rationale

Development of information systems that can track changes in risk factors and health outcomes are seen as key to intervention evaluation, both in public health surveillance (Halperin, 1992) and program evaluation traditions (Lipsey, 1996). Yet workplace based hazard surveillance systems have encountered a range of challenges (Silverstein, 1997a; Buckle, 1997b) and traditional health outcome surveillance systems may be relatively insensitive to the full burden of WMSDs (Fine et al., 1986). Workplace parties want more information than is usually provided by tracking workers' compensation statistics and hence large corporations have developed some very sophisticated occupational health and safety data systems (e.g. Ford Motor System in Sorock et al., 1997).

E.1 Ergonomic Assessments

The RSI committee determined that ongoing routine assessments of work and workstations and enhanced data collection on workplace exposures and WMSDs would assist them in reaching their goals of preventing the occurrence, reducing the severity through timely reporting and controlling the workplace exposures of WMSDs, and therefore they developed procedures for this purpose. The new procedures incorporated some of the existing data collection methods and add some new ones. The data collected are used to provide information to the committee on a quarterly basis on worker assessments, symptoms, actions taken to reduce workplace exposures and workplace health care visits. The databases are also used to trigger follow-up actions for the Health & Safety manager and the workplace ergonomist. A description of the main mechanisms for data collection follows. For each, a combination of coded and narrative data were devised, building on risk factor research from earlier phases and best practices (Sorock et al., 1997). The following description and discussion of the Ergonomic Assessment Tool (EAT) forms part of a working paper under development by Swift et al (2003).

E.1.1 Development of Ergonomic Assessment Tool

Elements included were the setup of various components of the workstation (screen position, monitor placement, keyboard and mouse, height of chair, telephone issues, etc), the visual environment, employee posture and arrangement of work breaks. Employees were asked to report any symptoms consistent with WMSD, on a section of the form stating the symptom location and severity based on best practice suggestions (Cohen et al 1997; Hagberg et al 1995). A risk factor checklist to reflect broader aspects of work was also developed. The checklist was built upon information currently collected as part of an accident investigation, findings from the Institute's earlier surveys at the Star (Polanyi et al 1997) and suggestions from the literature. Early on, it was decided that the assessment form should be limited to one-page, to keep the items to a manageable number to ensure compliance. (Sorock et al., 1997)

The tool developed consists of the following components as outlined in Figure E.1.1:

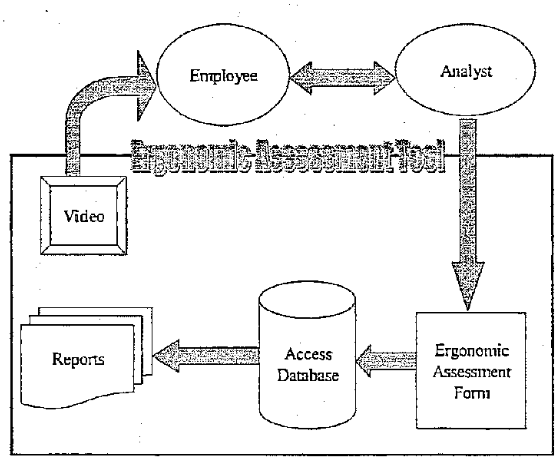


Figure 1

Figure E.1.1
Flow diagram of Ergonomic Assessment Tool components and information flow.

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- A 20-minute video produced by Toronto Star TV, presents some of the Institute's findings from earlier surveys conducted at the Star. The video also shows a complete workstation assessment including the interaction between the assessor and employee. The assessment is intermingled with an announcer explaining each particular component in the assessment. The video is shown to new employees as part of their orientation to the Star.
- An Ergonomic Assessment Form filled in by a trained analyst when visiting an employee at their workstation. The form consists of 5 major parts: ,(1) an introductory section (employee's name, work department and department section, job title, analyst assessing the employee and date of assessment), (2) space for a section reporting any symptoms, (3) a section recording results of the workstation assessment, (4) a risk factor checklist and (5) recommendations along with a follow-up date. See Appendix II for a copy of the latest version of the Ergonomic Report/Workstation Assessment Form. The form has undergone two revisions from the original. Included were two additional questions in the experiencing symptoms section (i.e. if experiencing symptoms then (1) is pain/discomfort intermittent and (2) do you think it is work-related). Also included were fingers, thumb and head for the body parts affected. The addition of mini breaks (i.e. 60 second break for every 20 minutes work) was included in the workstation assessments as well as an indication if any corrective action is to be undertaken for each workstation element. Finally an indication if working with a shared workstation was a risk factor was added to the form.
- An instruction booklet for completing the forms was developed. Forty-five analysts, volunteers from various departments within the Star, underwent a training program for one and half days. They were given a case study on the conditions of an employee's workstation and then asked to fill-in the form with what they felt were appropriate assessments of that particular workstation. Their answers were then compared with each other and discussed, to get a consistent understanding of what was actually meant by a particular assessment (e.g. 'good' versus 'fair' versus 'poor'). This process was repeated for several different scenarios. Analysts were also instructed to talk about various types of stretching exercises with the employee.
- A Microsoft Access 2000 database residing at the Star was designed and implemented by IWH, for the entry of the Ergonomic Assessment Forms. The database is split into a "data" database (with data tables only) and a "application" database (containing all other objects). Changes to the application were made offsite at IWH and easily merged back into the application database without disturbing the data. The database was designed with employee information in one table linked by a one-to-many relationship to the corresponding assessment(s) in another table. This allows separate entry for the ergonomic assessments of a given employee as they occur. The database automatically determines (and stores) the body site(s) which have the highest level of pain/discomfort intensity, and the workstation issue(s) obtaining the worst assessment for a given Ergonomic Assessment Form. It contains an ad-hoc query facility allowing the user to easily explore the data. It also produces several different reports covering a user-specified time period.

E.1.2 Results to date

Collection of data started Feb 11, 1999 and, for the purposes of this report, ended Apr 11 2003. There are 1092 Ergonomic Assessment Forms (EAF) among 881 employees in the database. The EAFs comprised 711 employees with only one EAF and 171 employers with multiple EAFs (138 employees had two EAFs, 24 employees had three EAFs, 7 employees had four EAFs, 1 employee had five EAFs). The data is reasonably complete, with the exception of the follow-up data (completed (yes/no)), which had been left blank. An administrative staff member from Human Resources, who entered the forms into the Access database, said that equipment which needed to be purchased, was noted in the recommendations and ordered shortly after the ergonomic assessment. Three of the Ergonomic Assessment Forms had the assessment date left blank, six of them had no department for the employee, and two had neither assessment date nor department reported. These eleven EAFs are excluded from subsequent reporting of the data. Of the 881 employees, 138 had never been surveyed in any other phase of the Institute's study. Only 466 were involved with Phase 1 and/or Phase 3 studies (see sections F.2 and G.1 below), which included questions on demographic data.

In table E.1.1, it can seen that different departments started at differing times, with the bulk of assessments from Circulation and Corporate Systems occurring in the first time period 1999-2000 while Pre-Press had more assessments done in the second time period.

Table E.1.1 The breakdown of EAFs by department and time period*

Department	# in 1999-2000	# in 2001-2003	Total # of Assessments 1999 - 2003
Advertising	119	139	258
Circulation	206	53	259
Communications & Market Planning	23	30	53
Corporate Systems	75	7	82
Editorial	121	95	216
Finance & Administration	40	18	58
Human Resources	19	8	27
PrePress	25	67	92
Production VPC	31	1	32
TMG TV	0	1	1
TorStar Electronic Pub	0	3	3
TOTAL	659	422	1081

*For time period 1999-2000 versus 2001-2003, $\chi^2=172.85$ for 10 df, $p < 0.0001$.

There were forty-one trained representatives who had completed at least one ergonomic assessment. Four of the representatives, who had undergone the training, had not completed any assessments. The breakdown by number of assessments completed was: twenty-one representatives had 5 or fewer assessment forms completed, sixteen representatives had between 11 to 53 assessment forms completed, while five representatives where responsible for 571 (or 52%) of the completed forms. For the most part, the representatives were department based, however one representative, who had completed 201 assessments, covered most of The Toronto Star's departments.

Table E.1.2 shows the mean assessment grades of various workstation and work style issues by the two time periods of assessment. The assessments have been rescaled to a 5-point scale with endpoints of –2 (Very poor) and +2 (Very good). The assessments for many of the issues show a significant increase in their value measured in the second time period compared to the first period. The issue involving taking regular breaks from work is the only one displaying the opposite trend (though differences between the two time periods are not significant). The number of workstation assessments for Document Holders and Mouse Position is lower because many workstations don't use these items and therefore these issues are often checked as not applicable. All the mean grade values lie between what would be interpreted as being Fair and Good.

Table E.1.2. Mean Assessment Grades of Various Workstation and Work Style Issues by Two Time Periods

	1999 - 2000			2001 - 2003			T-Test		
Issue	**n**	**Mean[1]**	**Std Err**	**n**	**Mean[1]**	**Std Err**	**t Value**	**DF**	**Pr > |t|**
Posture	628	0.764	0.035	402	0.915	0.037	-2.97	955	**0.0031**
Monitor Height	640	0.641	0.041	398	0.776	0.045	-2.23	933	**0.0261**
Monitor Distance	620	0.926	0.038	389	1.077	0.032	-3.03	1001	**0.0025**
Glare/Reflection	605	0.962	0.039	383	1.044	0.037	-1.51	953	0.1314
Document Holder	369	0.350	0.064	272	0.662	0.063	-3.47	627	**0.0006**
Chair Adjustments	627	0.839	0.044	392	0.951	0.042	-1.86	985	0.0635
Keyboard Height	629	0.722	0.041	387	0.847	0.045	-2.07	913	**0.0383**
Mouse Position	481	0.790	0.048	377	0.843	0.043	-0.82	856	0.4125
Telephone Issues	564	0.589	0.048	332	0.744	0.052	-2.21	793	**0.0275**
Workstation Layout	627	0.815	0.036	392	0.908	0.035	-1.87	975	0.0617
Breaks	598	1.122	0.036	377	1.042	0.042	1.42	973	0.1559

[1] Based on the values -2 =Very Poor, -1=Poor, 0=Fair, +1=Good, +2=Very Good

Tests of equality of variance of the issues between the two time periods indicates they are not equal, except for the 'Breaks' issue, therefore a correction due to Satterthwaite (1946) for the degrees of freedom (DF) for an approximate t statistic was applied as needed. Significant (at 95% confidence level) p-values are shown by bold type.

Table E.1.3 examines whether employees were experiencing any symptoms of pain or discomfort by the period of the assessment. For the total time period covered the estimated prevalence of pain/disability was 62%, very similar to the one-year prevalence's observed by the two workforce wide cross-sectional studies (P1 and Q4, see section G1) conducted at the Star.

Table E.1.3 Symptom reporting on EAF by time period

Experiencing Symptoms	**Time Period**		**Total**
	1999 - 2000	**2001 - 2003**	
No	276 (41.9%)	134 (31.7%)	410 (37.9%)
Yes	383 (58.1%)	288 (68.3%)	671 (62.1%)
Total	659	422	1081 (100.0%)

The assessment forms have proportionately more employees experiencing symptoms in the later time period (χ^2 = 11.21 for 1df p=0.0008) perhaps because of the greater acceptance of RSI/WMSD in the workplace, greater body awareness by employees or declining fear of reporting. Unfortunately, as can be seen in table E.1.4, intensity of symptoms does not seem to have decreased in the latter period. Alternatively, the ergonomic assessor may have developed trust among employees to increase their willingness to report symptoms. Such findings are common in active surveillance systems, which uncover hidden burdens of illness or injury but make short-term conclusions and justification of the use of active surveillance systems somewhat more difficult.

Table E.1.4 Body area affected by pain/discomfort by time period.

Body Area	1999 - 2000			2001 - 2003			T-Test		
	N	Mean[1]	Std Err	N	Mean[1]	Std Err	t Value	DF	Pr > |t|
Neck	192	2.77	0.055	139	3.06	0.754	-3.53	329	**0.0005**
Shoulder	183	2.76	0.054	138	3.03	0.724	-3.20	319	**0.0015**
Elbow	85	2.86	0.087	89	3.15	0.732	-2.47	172	**0.0146**
Hand Wrist	190	2.82	0.059	151	3.16	0.731	-4.03	339	**<0.0001**
Upper Back	103	2.83	0.079	63	3.06	0.759	-1.90	164	0.0589
Lower Back	114	2.69	0.072	62	2.90	0.804	-1.71	174	0.0946

[1] 2=Mild Pain, 3=Moderate Pain, 4=Severe Pain, 5=Unbearable Pain

The tests of equality of variance of pain/discomfort for the various body parts showed that the assumption that the variances of the two samples were equal could not be rejected; therefore the usual values for the t statistic are used for all the body parts.

There were enough responses for some of the "Other/Specify" body sites, which lead to the revision of the form; adding arm, fingers, thumb and head as new body parts.

Table E.1.5 shows that proportionately more of those assessed during the first time period reported organizational risk factors determined in part as the cause of their pain or discomfort. This may have been due to the Star's efforts in reducing the effects of these factors, hence leading to the observed reduction in the risk checklists, although some issues e.g., work intensity/deadlines, showed no change in repeat x-sectional surveys (section G1).

Table E.1.5 Organizational risk factors by time period.

Organizational Risk Factor	Time Periods				$\chi 2$	DF	Pr > $\chi 2$
	1999-2000 (n=659)		2001-2003 (n=422)				
	#	%	#	%			
Overtime	90	13.7	36	3.3	6.57	1	**0.0104**
Non-standard Work Hours	48	7.3	13	3.1	8.54	1	**0.0035**
Short Staff	68	10.3	22	2.0	8.79	1	**0.0030**
Work Intensity/Deadlines	155	23.5	63	14.9	11.80	1	**0.0006**
Technical Difficulties	48	7.3	12	2.8	9.67	1	**0.0019**
Special Projects	92	14.0	24	5.7	18.38	1	**<0.0001**

Seven hundred and twelve forms contained recommendations for adjustments in workstations and work style and changes in equipment purchase from the assessments carried out. Some of comments included are:

- "needs glare screen, headset... have booked appointment to re-arrange desk set up Wed Nov 28

–2 PM"

- "2 workstations – one keyboard on desk –too high…keyboard tray bounces-not stable…new keyboard tray needed…ideally a different desk "
- "1) mouse tray for Intercon, chair provides poor low back support-unable to adjust 2) new chair"
- "1) Chair arms/keyboard too high-adjusted 2) tends to lean into screen-suggested to wear her glasses 3) needs to remember to take breaks 4) suggested try mousing with L hand and use keyboard shortcuts for text"
- "adjusted height of monitor up to eye level. Adjstd chair to proper height and angle. Taught re: use of chair adjmts. If using phone more than usual, will move phone closer to decrease reaching repeatitively. Indicated that he plans to get document holder"
- "Typewriter & PC should be moved to an ergonomically correct position…more than one person working at that station"
- "has experienced pain in his right elbow. He has seem his family doctor & we've made some adjustments to his desk. I've refered him to the Stat Physiotherapist."
- "It is a 'mousing' problem … – her personal work staion is fine – she requires wrist support …"
- "screen should have more contrast … needs to center herself over one desk or the other…document holder"

Many of the recommendations referred to fact that an employee worked at more than one workstation, so this was also added to the checklist of possible organizational risk factors on the assessment forms. Sorock et al (1997) discuss the advantages of including narrative fields in injury surveillance data. A full qualitative analysis of these recommendations is planned to be included in Swift et al (2003) but some preliminary set of themes to be explored include:

- the nature of the verbs used from more tentative e.g., suggest, to more forceful e.g., order
- the time frame indicated e.g., raised or lowered [immediately] versus will provide [future]
- the specific equipment mentioned e.g, document holder, headset
- the resources to be mobilized to achieve change
- the contextual issues raised that facilitate or impede better workstation setups

E.1.3 Discussion of Ergonomic Assessment Activity

Klaucke et al (1988) and Sorock et al (1997) have both made suggestions regarding workplace surveillance methodologies and developed guidelines for evaluation of surveillance systems.

A. Health Importance

Klaucke et al (1988) suggest that three of the most important categories that a surveillance system should contain to describe the importance of a health event are:

1. Number of cases, incidence and prevalence.
2. Indices of severity
3. Preventability

The Ergonomic Assessment Tool (EAT) addresses all three categories. It includes questions regarding an employee's pain/discomfort (if experiencing symptoms (yes/no)), therefore the number of cases and prevalence can be calculated for any time period covered by the system. It includes indices of pain/discomfort over the last week for several body parts, whether or not the pain/discomfort is intermittent, and if they feel their pain/discomfort is work-related. The EAT's workstation and work style assessments as well as work organizational factors provide links to possible risk factors and thus provide possible areas for prevention.

The EAT does not include methods to determine indices of lost productivity or medical costs of RSI. It was felt this would make the EAT too complicated because it would require a number of linkages with different sources and could affect the timeliness of reporting.

B. Usefulness of Surveillance System

Actions were taken immediately as a result of assessments performed by the trained representatives with the employee at his or her workstation. This was evident from the remarks section of the database, where the representatives made adjustments to the workstation (e.g. "adjusted height of monitor – too high", "changed keyboard position so shoulders were at rest"), work style (e.g. "needs to cleanup workstation to make room for commonly used equip", "suggestions given re frequent breaks, exercises","showed him 'pencil' method of using function keys") and ordered new furniture when deemed necessary (e.g. "given headset for phone", "required mouse pad – wrist support", "ordered different keyboard tray for him").

Capturing the information obtained from the Ergonomic Assessment Forms into a database is necessary for any surveillance system to be efficient (Sorock et al 1997). Calculation and tracking of such information as the ongoing prevalence of discomfort/pain, average pain intensity, average rating of the assessments are made easily. See Appendix III for an example of one of the figures that can be produced by EAT. Ad-hoc querying is also provided by the system. Trends in the data become readily apparent, as evidenced by the previous tables.

C. Evaluation of System Attributes

Klaucke et al (1988) and Sorock et al (1997) both define several attributes that a surveillance system should have. Below we discuss these as they apply to the Ergonomic Assessment Tool (EAT).

(1) *Simplicity* – The simplicity of a surveillance system refers to both its structure and ease of operation. Surveillance systems should be as simple as possible while still meeting their objectives. The EAT relies on only a one-page form filled out by a representative in interaction with an employee in performing an evaluation of an employee's workstation. Several assessors were assigned and underwent staff training requiring only two half-day sessions. It takes approximately half an hour to perform an assessment with the employee and fill out the Ergonomic Assessment Form. Some representatives reported that it took too long to adequately complete an evaluation, adding additional stress and time to their already burdensome job loads. This explains why the distribution in the number of assessments completed by the representatives was not uniform, with half the representatives completing less than 10 assessments. Two hundred and one assessments were completed by one of the representatives, whose main role at The Star is to provide advice and help on ergonomic issues. It may be better to hire one or two additional personnel to conduct the assessments as part of their job function and to have the rest of the representatives as 'good will' ambassadors in each department (i.e. someone familiar with the assessments and who can answer staff questions about the process).

(2) *Flexibility* – A flexible surveillance system can adapt to changing information needs or operating conditions (e.g. changes in case definitions, variations in reporting sources) with little additional cost in time, personnel, or allocated funds. Programming changes to the database component of the EAT were accomplished quickly and with little cost involved.

(3) *Acceptability* – Acceptability reflects the willingness of individuals and organizations to participate in the surveillance system. Considerable interest has been expressed in the system, with active suggestions of modifications and a request for multi-user read access for all RSI Committee members. A multi-user version of the database is being developed by computer systems staff of The Star.

(4) *Sensitivity* – The sensitivity of a surveillance system can be considered the proportion of cases experiencing symptoms. Sixty-two percent of Star employees report some pain/discomfort symptoms. This is a similar proportion obtained by the two cross-sectional surveys. The willingness of employees to report their status is high. Changes in sensitivity can often be precipitated by heightened awareness of a disease, which may explain the increase of reported pain/discomfort over time.

(5) *Positive Predictive Value* – Positive predictive value is the proportion of persons identified as having cases who actually do have the condition under surveillance. We did not have a way to ascertain if the employee's reporting of symptoms was true or not.

(6) *Representativeness* – A surveillance system that is representative accurately describes both the occurrence of a health event over time and its distribution in the population by place and person. The EAT achieved high coverage with 881 employees reporting out of approximately 1200 possible employees (73%). It is planned to cover everyone during two-year periods. When all the employees achieve multiple assessments done over time, then survival analysis could be conducted with 'experiencing symptoms (yes/no) as the dependent variable. The only demographic variables presently captured are a employee's department and job title. It remains to integrate the system with the Parklane personnel information module (e.g. age, sex).

(7) *Timeliness* – Timeliness reflects the speed or delay between steps in a surveillance system. Although considerable upfront time, about six months, was spent in designing and implementing the computer system to house the data collected, once completing this task, the analyzing and preparing and disseminating of surveillance reports was made routine. It was left to a Human Relations staff member to transfer the information collected on the forms to the database. Since this data entry was an additional add-on function to the staff's position, the forms would often had to wait until the staff member had time to enter the data into the computer database. Simplicity is closely related to timeliness and will affect the amount of resources that are required to operate the system (Klauke et al 1988). A staff member with designated time to perform data entry for the EAT would relieve this bottleneck.

(8) *Economics* - Surveillance systems require economic justification (Sorock et al 1997), so the cost versus benefit of implementing a surveillance system like the one undertaken by the Star would need to be compared. Unfortunately, we may not have adequate data for such an analysis because of difficulties associated with disaggregation of absence data, and health care utilization costs outside the control of the workplace (see section G.2 below).

D. Future Improvements

A definition of 'case levels' needs to be made for the Ergonomic Assessment Tool. The Hunting et al (1994) and NIOSH definitions for case levels can't be used in this instance since they both require additional information regarding a subject's average pain over the past year and highest level of pain during the past year. For the EAT, which only relies on pain intensity within the past week, some sort of combination of both maximum pain intensity during the past 7 days and the number of body sites affected could be used. Both maximum pain intensity and number of body sites are automatically determined and stored by the database. Setting acceptable level(s) for average pain and average values of workstation assessments also needs to be decided.

Several additional improvements to the database are also suggested. Additional graphic reports, for example, a plot of average pain by different body parts for a given time period, should be added. A link to some of additional modules used by the Human Resources department should be explored; providing additional demographics as well as using the existing employee names instead of reentering them. Key words should be developed for narrative searching in the remarks section of the form. This could identify special situations that are not covered by current coding schemes. Finally an add-on statistics library available to MS-Access (refer to: http://www.fmsinc.com/products/) should be considered. It enables a powerful data analysis tool for Access; calculating regressions, percentiles, ANOVA, t-Tests, chi-square, etc. Its' survival analysis component could be used on the multiple assessments a person receives over time, with the presence of pain/disability symptoms as the dependent variable.

E.2 Clinical Course Monitoring

Rationale

Our best understanding of the natural history of upper extremity WMSD suggests that the majority will recover in a short time (Hashemi et al.,1998; Beaton,1995), and that simple interventions are effective in the majority (Yassi ,1997). Nevertheless, compared to other types of soft-tissue injury, many WMSDs appear to be further along in their clinical course by the time they are reported to the workplace and lost time starts (Yassi et al.,1996). For example, almost all the "accident" reports submitted for WMSD in the first quarter of 1998 at the workplace, also had already visited physiotherapists or other clinical practitioners. Hence it was important to assess what level of severity those employees presenting to the health center were at, and assess their clinical course. More details on this component are provided in the appended IWH working paper "Outcomes and self-efficacy of workers presenting to occupational health unit with upper extremity or low back pain"

E.2.1 Methods

Population

All workers reporting new or aggravated upper limb or low back symptoms consistent with WMSD to the workplace (Health center) were asked to participate. Self-completed questionnaire packages were given out at the time of reporting to the Health Centre to those workers that were eligible, agreed to participate in The Treatment Monitoring Study and provided informed consent (see Appendix IV). This was chosen as the baseline measure since it identified the time in which the worker crossed the threshold of needing care. The follow-up self-completed questionnaire packages were mailed to participants at 4-weeks and 12-weeks after receiving the baseline questionnaire package. In addition, we have collaborated in the exploration of routinely collected data of the employees attending therapy at The Orthopaedic Therapy Clinic at The Toronto Star (One Yonge St.).

Measures

Based on best practice suggestions (Cohen et al., 1997; Hagberg et al., 1995), the questionnaire included a description of the symptom location, nature and severity. This information permits recreation of various symptom-based case definitions of WMSD for comparison with the literature (Polanyi, et al. 1997; Hunting, et al. 1994; Bernard, et al. 1994). In addition, measures of the impact of the symptoms on the worker's health were obtained. Analysis of phase II data suggests that these are useful predictors of outcome. Three measures were used: the QuickDASH (Disabilities of the Arm Shoulder & Hand (Polanyi, 1997; Hudak, 1996)), the Roland Morris Questionnaire for those with low back pain and the Work Limitations Questionnaire (WLQ) (Lerner, 1997).

Development of the QuickDASH (a shortened version of the DASH, Disabilities of the Arm, Shoulder and Hand) was described in the section on Preliminary Studies. It is an 11 item questionnaire, with a 4 item work disability module. In both modules, participants are asked to rate the degree of difficulty they have with a given task. Scores are obtained for the 11 item component and the 4 item work module independently. Scores range from 0 to 100 (more disability) and it is designed to quantify physical function and symptoms in persons with any or multiple disorders of the upper limb. Versions used in 1996 (Phase I) and 1997 (Phase II) demonstrated good construct validity and sensitivity to both change in case status over the one year, as well as self-rated change (improvement and deterioration). This 11-item measure has demonstrated strong properties of test-retest reliability (ICC = 0.94), construct validity and responsiveness (Beaton et al, 2003).

The Roland Morris Questionnaire (RMQ) is used to measure functional status in those with low back pain. This measure has also been extensively studied for its reliability, validity and responsiveness to treatment effects (Roland & Morris, 1983). Scores range from 0 to 24 (more difficulty).

The Work Limitations Questionnaire (WLQ) asks in more detail about the amount of time for which participants have difficulty performing various aspects of their work relevant to employers, supervisors and workers alike (Lerner et al., 1997). Aspects of work include work scheduling, physical demands, mental demands, social demands and output demands. A shortened version of the WLQ (16 items), used in Phase II, showed gradation with symptom severity. Psychometric testing of the WLQ-16 was performed using this sample and shows evidence of construct validity, internal consistency and responsiveness (Beaton & Kennedy, 2003, unpublished). The WLQ-16 measures four dimensions: Physical demands, Output demands, Time management and Mental-interpersonal. Scores range from 0 to 100 (less limitation).

Along with the impact of the disorder other prognostic information were gathered, including condition characteristics, worker expectations of recovery and self-efficacy. There is moderate evidence to suggest that self-efficacy (a feeling that one has the ability to manage or control one's symptoms), is associated with improved health outcomes (Lorig, et al. ,1993; May et al. 1997; Anderson et al., 1995; Holden ,1991). Given that self-efficacy is considered a modifiable attribute, the implications could be great. Self-efficacy was also identified as a prognostic factor in the qualitative work. The self-efficacy scale, used in Phase II and adopted from an arthritis self-efficacy measure (Anderson et al., 1995; Lorig et al., 1989) was used to ascertain worker's feelings about their ability to control their symptoms.

Randomized controlled trials (Lorig, et al., 1993; Bandura, 1997) have shown that self-efficacy is a modifiable trait. As such, it could be an advantage to identify factors that are associated with a positive change in self-efficacy in disorders where facilitating high levels of self-efficacy could in fact improve the outcomes of disorders (Bandura, 1997)

Analysis

We developed prognostic models for prediction of higher levels of self-efficacy at the three month point.

E.2.2. Results

Data were collected from a cohort of 45 workers who reported to the Health Centre with upper extremity or low back musculoskeletal pain or discomfort and who agreed to participate in the study. The mean age of the sample was 42.4 years. A majority of the workers (63.6%) were female and almost 80% reported more than one body part in pain. Only 7.7% had ever lost work time due to their reported problem and therefore we are describing a sample of workers that continue to work despite their reporting of upper extremity or low back pain.

The mean change in burden measures (between baseline and 12-weeks follow-up) showed an improvement in all measures: QuickDASH (15.4 points), Roland Morris Questionnaire (RMQ) (4 points), self-efficacy for pain (16.6 points) and WLQ-16 (all subscales). Paired t-tests for change scores (between baseline and 12-week follow-up) were all significant ($p<0.05$) for each of the outcomes except for the RMQ.

The mean scores plotted over time for the QuickDASH, RMQ, self-efficacy for pain and WLQ-16 (by subscales) showed a general trend in improvement over time in mean disability (QuickDASH, RMQ), self-efficacy and ability to function at work.

The usual course or trajectories of response among the workers were plotted over time for each of the burden measures. Distinct patterns were identified including individuals who showed change (> $MDC_{95\%}$, either improvement or deterioration) versus no change ($MDC_{95\%}$). Generally, most workers showed improvement or no change, with very few getting worse over the 12-week follow-up.

Univariate regression analysis identified baseline variables significantly associated ($p<0.25$) with self-efficacy for pain at 12 weeks. Generally, these univariate models indicate that higher self-efficacy for pain and worker prediction that they will get better soon were associated with higher self-efficacy scores at 12-weeks, when age and gender were controlled. When these remaining variables were entered into a multivariable model, both remained significant with $p<0.05$.

E.2.3 Planned Directions

Of all the workers reporting to the Health Center, some were self-managing their symptoms (ice, rest) and others were referred to physiotherapy. We plan to do a group level comparison of respondents in the Treatment Monitoring cohort versus all those attending The Orthopaedic Therapy Clinic at The Toronto Star during the same period. This would give us a better idea of how well the Treatment Monitoring study participants compared to the wider population in terms of age, sex, disability and region affected. Summaries will be made at an aggregate level only.

We are currently assisting The Orthopaedic Therapy Clinic with summarizing demographics and a description of outcomes for the clients attending on-site physiotherapy (Beaton et al., in preparation). Presentation of preliminary analyses by the onsite physiotherapist indicated a trend towards shorter times between onset of symptoms and treatment over the period of the RSI Program (see figure E.2.1).

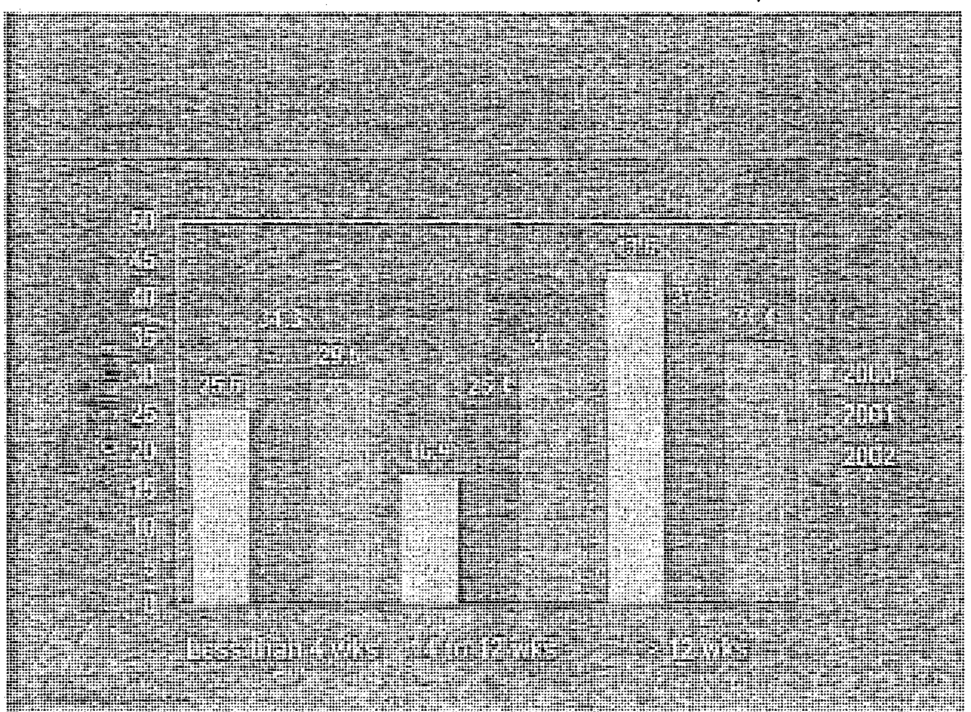

Figure E.2.1 Time from symptom onset to treatment among on-site physiotherapy employee clients.

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When the mean pain severity scores (NPRS) of worker's attending The Orthopaedic Therapy Clinic were plotted over time, they showed improvement (decreasing mean pain severity ratings) from baseline to 12-week follow-up (see figure E.2.2). The mean change in pain severity from baseline to follow-up was 3.89.

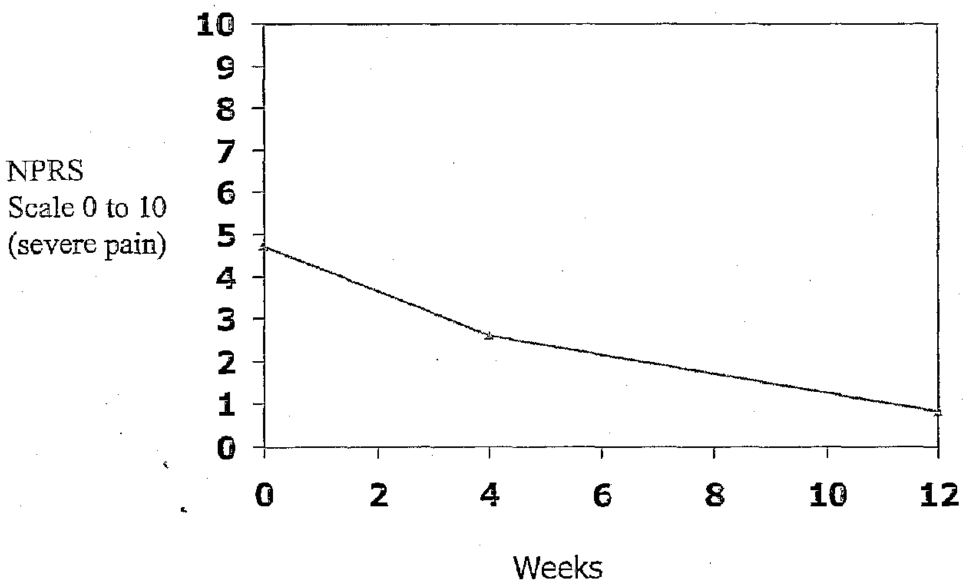


Figure E.2.2 Mean pain severity (NPRS-Numeric Pain Rating Scale) over time

We have created an analytic plan for determining factors (Potential baseline predictors include: Age, gender, duration of disorder, pain severity, affected region, disability) predictive of a better outcome at discharge from physiotherapy (lower pain severity, lower DASH scores) among those employees attending The Orthopaedic Therapy Clinic at The Toronto Star (Beaton et al, in preparation).

F. Departmental Move and Team Reorganization Evaluation

Background

Workplace organization can have a substantial effect on injury rates. Unpublished data from Ontario show that in most types of work, there is at least an order of magnitude difference in rates between the 'better' and 'worse' companies. These are typically consistent from year to year, showing they are not statistical artifacts. Shannon, Mayr and Haines (1997) have identified factors that are consistently, across studies, related to lower injury rates. Hofman and Morgeson (2004) investigated the role of leadership, while Zacharatos and Barling (2004) have shown the effect of high performance work systems. Murphy and Sauter (2004) recently summarized the importance of work organization on health and encouraged further research.

We were thus excited when, as we were planning our study, The Star announced that it would be reorganizing some of its operations, giving us an opportunity to study the effect of this organizational change, occurring concurrently with the ergonomic initiatives. . The Star planned to create teams among the advertising department employees. The teams would be flexible working groups whose members would specialize in certain areas of advertising (e.g., automobiles). Focused study of the team reorganization was designed to facilitate insight not only into the implementation of the RSI Program in one section of the company but also into the degree of change in risk factors for WMSD that can be brought about by feasible work reorganization and workstation re-design in office environments. Organizational change is a common feature of workplaces today. Understanding how to build macro- and micro-ergonomic best practice into organizational change processes is crucial to preventing WMSD. On the positive side, organizational changes have improved health outcomes in a variety of settings (Karasek, 1992; Cahill, 1996). In the Pod reorganization envisioned, significant changes to computer systems were envisaged which had the possibility to deal with computer related problems (Carayon et al., 1998) and computer use mastery (Huuhtanen and Leino, 1992), issues which appear to be important. The entire group moved to a completely new area on a currently empty floor with new furniture and workstations. The proposed reorganization also involved changes to business processes which were aimed at greater task coordination, work support from a group (the team members) and more flexible task assignment while maintaining job security, all of which might reduce WMSD risks.

We therefore built on the intensive exposure assessment work to assess change among a small group of employees and conducted questionnaires pre and post the team reorganization and move to assess change more broadly.

F.1 Intensive Exposure Assessment Applied to Reorganization and Move

Building on methods described in section D.1, we were interested in analyzing change in more biomechanical measures as a result of the reorganization and move.

Methods

On the same subset of employees in Advertising and matched control jobs as described in section D.1, we have data using a variety of exposure metrics across three years: 1999, before the move and team re-organization; 2000, after much of the move but limited workstation adjustment in the winter and some more adjustment in the summer but no team training; and 2001, after team training and workstation assessments (section E.1) had been completed.

So far, we have descriptively analyzed the posture and dimension data only, given the analytic work involved in linkage with other metric,s as per section D.1, and the need to feedback our preliminary findings to the RSI Committee during the move and reorganization process. We provided several reports: one in February, 2000 to reflect on the move to new workstations, when only 25% of the workstations observed had been adjusted by one of the people available within the Star, either due to special request as problems were developing or self adjustment; one in December, 2000, after more adjustments had been made; and one in August, 2002 after most of the move and re-organization had run its course.

In each case, workstation dimensions associated with VDT use were measured, as were key postures associated with keyboarding and mouse use (as per methods in D.1). Workstation layouts were noted, as were general observations that would affect the usability of the workstations and/or the postures required to use the workstations. The participants were asked if any changes or adjustments have been made to their workstations either by themselves or someone else. Participants were also given the opportunity to comment on the workstation and state any changes they would like to see.

Results & Discussion

We present the salient findings in cumulative fashion, i.e. when comments were relevant in later reports that were present in earlier ones, only the later reports are included. This material forms part of Wells et al (in preparation) listed in publications.

February 2000

Most employees surveyed had keyboard trays with adjustable height (36/41 surveyed). As can be seen from Figure F.1.1, there were no longer the extreme locations for the keyboards, but there were a range of heights indicating that people have taken advantage of the adjustment feature.

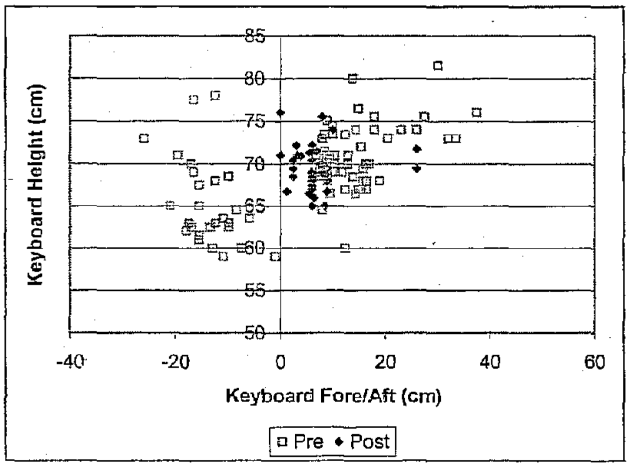


Figure F.1.1 Height of the J key from the floor vs. location of the keyboard from the front edge of the work surface. Negative fore/aft values are for pull out keyboard trays pre new workstations.

Several participants were concerned about banging their knees on the low bars that support the keyboard tray. Lack of stability of the keyboard tray was also noted at several stations. Several employees expressed a wish to do paperwork in front of their computers due to the nature of their job. However, they were limited by the lack of space to push their monitor and keyboard back.

Most people had adjusted the height of their chair. Some had had their chair fully adjusted for them. A few people noted difficulty in adjusting the arm rest width and seat tilt. It was observed that the new chairs did not always roll easily on the carpet. Thirteen percent of the people surveyed had been provided with plastic pads for the floor. Inability to move the chair easily may lead to poor practices such as twisting in the chair instead of moving the chair to work at a different part of the station or a forceful grasp of the hands to move the chair in.

Space was an issue. Twenty nine percent of the people surveyed made some comment regarding space. These comments include lack of wall space to post frequently used reference materials, insufficient space when exiting causing them to collide with the person behind them, not enough space on the desk to spread out, not enough file space, and insufficient storage space. These issues can lead to observable postures that may be less than optimal. For example, file boxes on the floor that are often reached for or stuff stored under the desk diminishing appropriate leg room. Another space issue observed was where to put the CPU if not under the monitor.

Dec 2000

Of particular interest in this report were changes in shoulder (Table F.1.1) and wrist postures with changes in the keyboard configurations described above.

Table F.1.1 Shoulder postures at keyboard (% within preferred range) *

Measure	Preferred Range	Summer 1999	Winter 2000	Summer 2000
Right Shoulder Abduction	0-20° *	57	66	36
Left Shoulder Abduction	0-20° *	67	74	45
Right Shoulder Flexion	0-20° *	47	47	60
Left Shoulder Flexion	0-20° *	45	50	62
Supported Right	Yes**	41	70	68
Supported Left	Yes**	39	87	79

* If arms are supported on armrests, shoulder flexion and abduction measures that exceed the preferred range represent minimal increases in risk of injury. Supported values outside range not accounted for.

** Includes both wrist and elbow support. Wrist support optimum when not typing

For shoulder postures, we found improvement in shoulder flexion and arm support but emphasized the need to look at shoulder abduction/support to see if there were concerns. For wrist postures, we reported that most people (>85%) were within the preferred ranges for extension and ulnar deviation throughout the period, except for a dip in the winter of 2000 e.g., right wrist extension to 76%, before many employees had their workstations fully adjusted.

August 2002

By this time, we noted that the new workstations had reduced extreme mouse positions and placed the mouse in much better positions. In Figure F.1.2, the successive reduction in variation is most notable, as is the centering on 0 in Figure F.1.3 showing reductions in mouse-keyboard height differences.

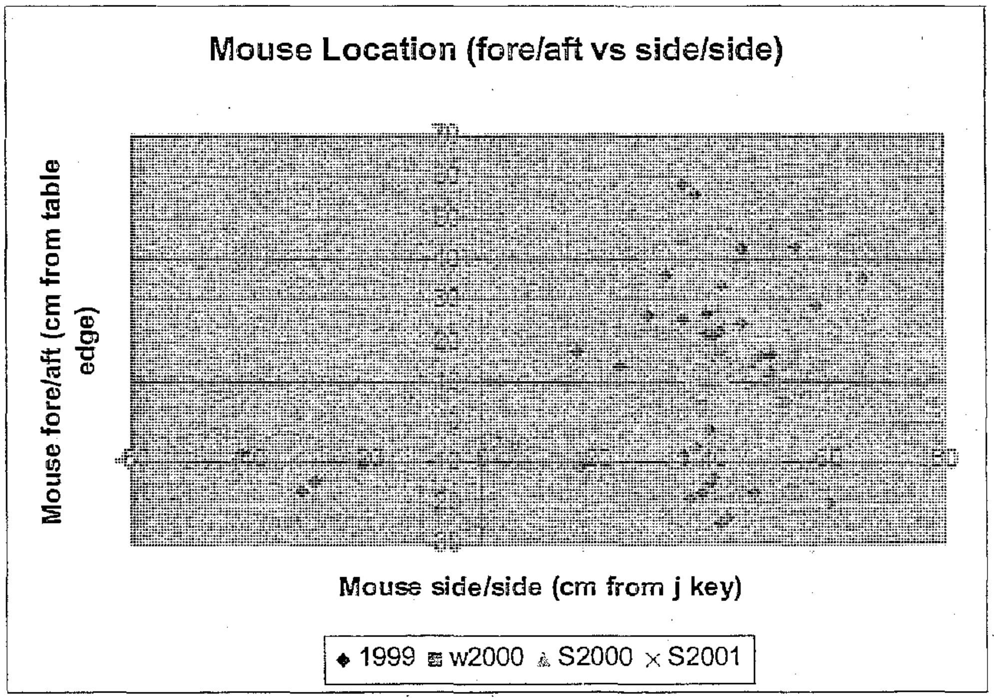


Figure F.1.2 Mouse fore/aft position vs mouse side/side position by measurement time

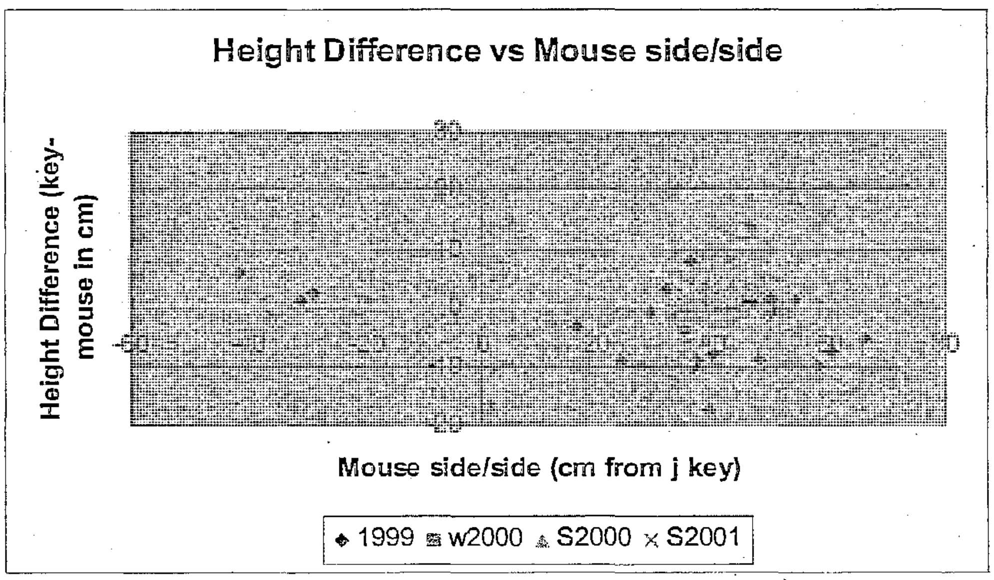


Figure F.1.3. Height difference between keyboard & mouse vs mouse side/side position by measurement time

Monitor heights also showed reduced variation over time with resultant improvement in mean head tilt (Figure F.1.4) and gaze (Figure F.1.5) angles. However, some monitors remained to high (summer, 2001) with more "up" postures than desirable.

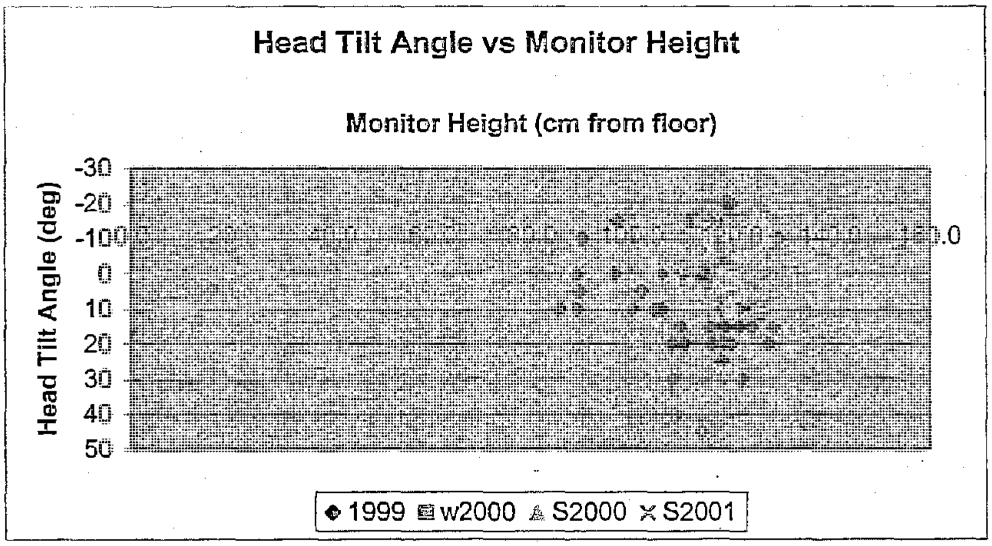


Figure F.1.4 Head tilt angle vs. monitor height by measurement time

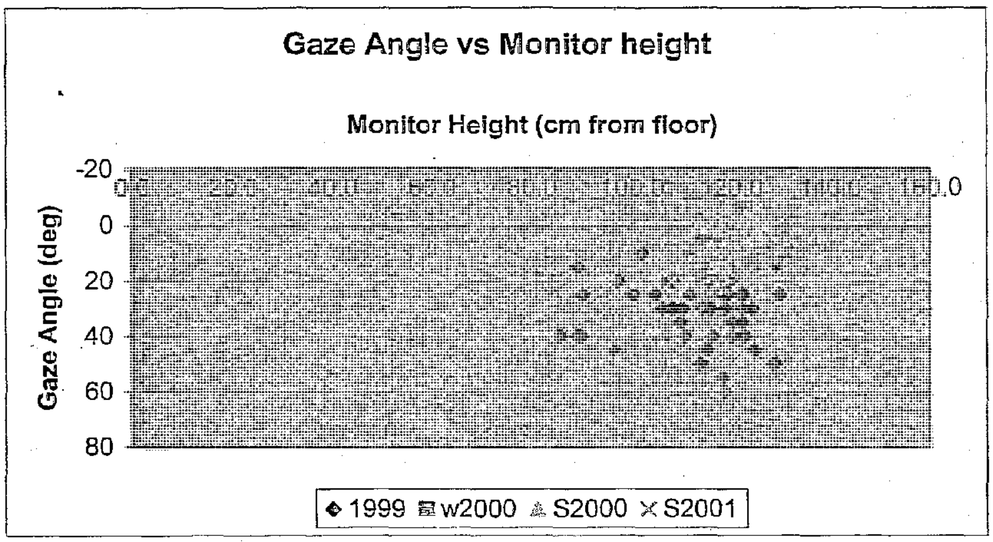
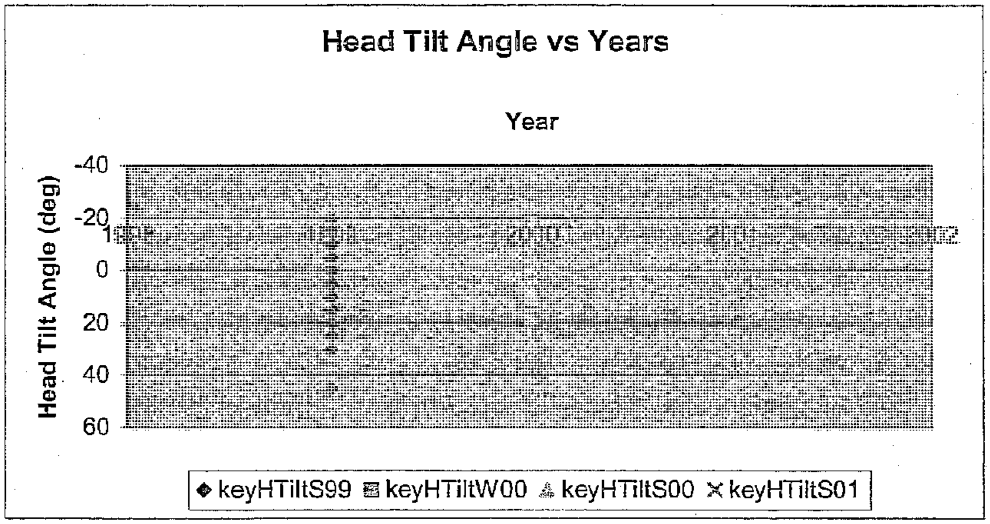


Figure F.1.5 Gaze angle vs. monitor height by measurement time

A closer examination of head tilt by year revealed considerable reduction in extreme head tilts with new workstation arrangements, except in cases with large monitors (Figure F.1.6)



F.1.6 Head tilt angle by year

Finally, head rotation also showed improvement to fewer extreme positions, likely due to the improved monitor-keyboard relationships, though a few outliers remained (Figure F.1.7).

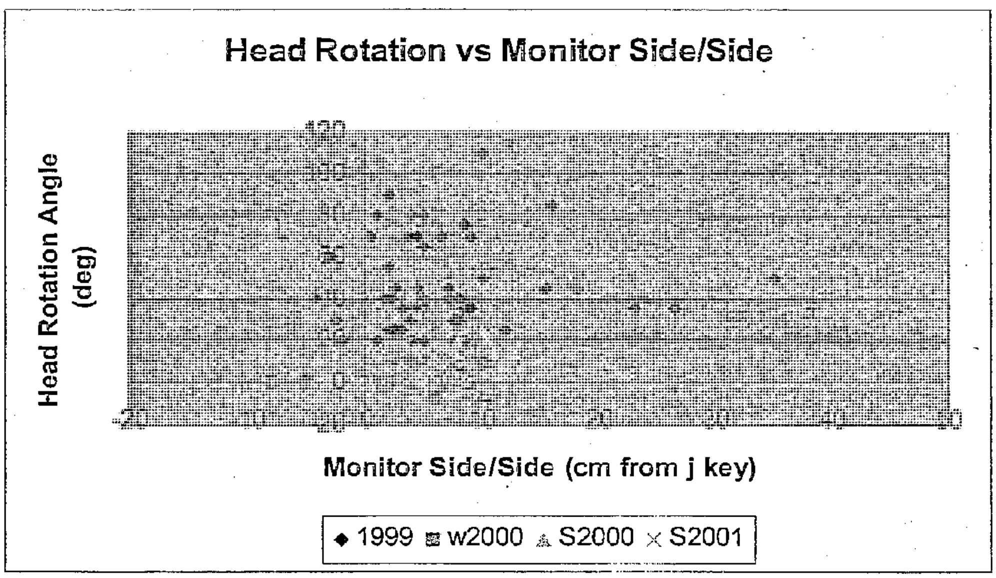


Figure F.1.7 Head rotation vs monitor side to side position by measurement time

So overall, we noted equipment-employee positional matching improvements over time.

Future analysis Plans

We will build on the conceptual model, presented in Figure D.1., to carefully construct the sets of relationships of interest, given the small number of subjects included in this portion of the study. Some factors which might come into play include: job categories, work environment factors (eg. keyboard height, use of a mouse), job design (number and distribution of tasks) as well as intrinsic individual factors and work style/work methods. In any business reorganization a number of job factors will be changed simultaneously. We suggest that suitably processed and analyzed electromyograms can reveal the net effect of all these factors over the reorganization. This aggregate measure is difficult to achieve in any other way. Conversely, it is difficult to determine which changes made the difference (if any) in the EMG. For this reason the other data collected is critical.

For interval scaled outcomes, ANCOVA models are proposed using pre-reorganization measures as covariates and post-reorganization measures as outcomes. The ANCOVA models will be gradually expanded to include some of these other factors and to clarify the relationship between changes in the simpler measures of work environment, workstation dimensions and equipment, documentation of tasks and task distribution (predictors of exposure), and changes in EMG parameters (internal exposure). For the binary outcomes, logistic regression will be used instead of ANCOVA, but the general modeling setup will be similar. These will be incorporated into Wells et al., (in preparation).

F.2 Questionnaire-Based Assessment of Change

This section sets out material that is part of Subrata et al., (in preparation) Our research objective was to identify predictors of changes in reported pain levels, especially whether the new teams experienced changes in their furniture/workstations, their tasks and their working relationships were associated with lower levels of pain.

Methods

Subjects: The group of respondents who formed the sample for pre- and post-intervention surveys was based on those people who were being moved into the new environment from different areas of the newspaper to form working groups as well as a comparable control sample based on jobs with initially comparable tasks that other participants held within the organization. Departments affected by the move in addition to advertising (not including ad takers) were composing and customer accounts for a total of 254 employees. The control group was composed of participants from accounting, advertising (ad takers only), circulation, finance, and payroll totaling 169 employees. Unfortunately, there were no suitable job-matched controls for the ad takers which reduced the final number of controls that could be included.

Of the 423 questionnaires distributed prior to the reorganization, 273 people responded, and when the cross-sectional survey in Phase 3 was distributed, 203 participants from that group responded. Although the number is smaller than we would have liked, these 203 respondents (128 affected by the reorganization and 75 controls) are the focus of this analysis.

Variables: Specific questions from the questionnaires were selected as possible predictors of changes in pain from pre- to post-intervention. Age and gender were included. Diagrams to detect non-optimal positioning of workstation components were used. Other task demands (e.g., deadline frequency) were also included. The physical variety of the job was surveyed by questions on time sitting continuously and time spent using other apparatus. Employees might have experienced changes over the past three years to their equipment, computer or job. Table 3 lists the ones included in the survey. A five-point response option was used for each question on the abbreviated instrument Karasek (1979) that included work stress subscales (i.e. decision authority, social support, psychological demands and skill discretion).

Analysis: Descriptive statistics were calculated for all of the variables used in the modeling procedure (Tables F.2.1 to F.2.3). Many variables were common to the pre- and post-intervention surveys; thus, change scores were calculated. Some variables were included only in the post-intervention survey, asking about changes that had occurred on jobs. Those in this analysis are shown in Tables F.2.1 – 3. Backwards list-wise deletion was used to select variables in the regression procedures.

Several preliminary models were run to try to predict a change in pain scores between the pre- and post-questionnaires; the starting model for each, i.e., showing all candidate variables are in Tables F.2.4 (a-g). Variables that were significant at the 0.05 level were retained for a final regression using backward elimination.

Results

There were 203 employees that responded to both pre- and post-intervention questionnaires. They tended to be predominantly female (72%) and had a mean age of 40 years, at the pre-intervention survey. The majority of them said that they had daily deadlines and sat continuously for over 2 hours at a time (Table F.2.1).

Table F.2. 1. Pre-Intervention

Variables (Continuous)	Potential Range	Actual Range	Sample Size (N)	Mean	SD
Age	18+ years	20 - 61 years	189	39.79	10.06
Keyboarding Time	0 - 8 hrs	0 - 8 hrs	203	3.53	2.44
Mouse Time	0 - 8 hrs	0 - 8 hrs	203	1.40	2.14
Telephone Time	0 - 8 hrs	0 - 8 hrs	203	3.47	2.49
Decision Authority	0 - 8	0 - 8	200	4.04	1.82
Social Support	0 - 12	0 - 12	199	7.86	2.16
Psychological Demands	0 - 8	1 - 8	201	5.37	1.41
Skill Discretion	0 - 12	1 - 11	200	6.66	1.76
Pain Intensity	0 - 100	0 - 100	200	25.04	26.20

Variables (Categorical)	Sample Size (N)	
Gender	N = 203	
- Male		27.6 %
- Female		72.4 %
Frequency of Deadlines	N = 192	
- No Deadlines		4.7 %
- Daily Deadlines		90.6 %
- Weekly Deadlines		2.1 %
- Seasonal / Long Term Deadlines		2.6 %
Sitting Continuously	N = 203	
< 0.5 hrs		1.5 %
0.5 to 1 hr		10.8 %
1 hr to 2 hours		27.1 %
> 2 hours		60.6 %
Team	N = 203	
- Yes		59.6 %
- No		40.4 %

In the post intervention questionnaire, 202 employees answered questions about changes over the past three years. Many had changed workstations, or received new workstations and/or new chairs. Many had changed computer hardware (68%), and mouse use was more common – 41% reported increased use (Table F.2.2).

Table F.2. 2. Post Intervention

Variables (Continuous)	Potential Range	(Actual Range)	Sample Size (N)	Mean	SD
Age	18+ years	23 – 64 years	203	42.36	10.00
Keyboarding Time	0 - 8 hrs	0.33 - 8 hrs	189	3.90	2.21
Mouse Time	0 - 8 hrs	0 - 8 hrs	179	2.54	2.05
Telephone Time	0 - 8 hrs	0 - 8 hrs	188	3.60	2.43
Decision Authority	0 - 8	0 - 8	198	4.06	1.70
Social Support	0 - 12	1 - 12	198	7.88	1.79
Psychological Demands	0 - 8	0 - 8	200	5.29	1.47
Skill Discretion	0 - 12	0 - 12	196	6.79	2.01
Pain Intensity	0-100	0 - 83.33	203	25.62	23.69

Variables (Categorical)	Sample Size (N)

<u>Frequency of Deadlines</u>	N = 197	
- No Deadlines	12.7 %	
- Daily Deadlines	79.2 %	
- Weekly Deadlines	6.1 %	
- Seasonal / Long Term Deadlines	2.0 %	
<u>Sitting Continuously</u>	N = 203	
< 0.5 hrs	0.5 %	
0.5 to 1 hr	10.3 %	
1 hr to 2 hours	29.6 %	
> 2 hours	59.6 %	
<u>Team</u>	N = 203	
- Yes	59.6 %	
- No	40.4 %	
<u>Equipment Changes Over the Past 3 Years</u>	<u>Sample Size (N)</u>	<u>Proportion of "Yes" Responses</u>
New workstation location	202	86.6 %
New workstation	202	83.2 %
New chair with armrests	202	82.7 %
Addition of wrist rests	202	36.6 %
Addition of document holder	202	29.7 %
<u>Computer Changes Over the Past 3 Years</u>	<u>Sample Size (N)</u>	<u>Proportion of "Yes" Responses</u>
New computer	202	68.3 %
New monitor	202	57.4 %
New keyboard	202	54.5 %
Addition of mouse	202	44.1 %
Increased use of mouse	202	42.6 %
Increased use of computer	202	27.7 %
New front end system	202	6.9 %
New computer programs	202	23.3 %
<u>Job Changes Over the Past 3 Years</u>	<u>Sample Size (N)</u>	<u>Proportion of "Yes" Responses</u>
Different job title/description	202	34.7 %
Different tasks in same job	202	42.6 %
Increased job responsibility	202	53.5 %
Decreased job responsibility	202	4.0 %
Less variety in job	202	10.4 %
Broader job scope	202	29.2 %
Service Area contracted out	202	3.0 %
Assigned to diff. group / unit	202	22.8 %
New Team	202	25.2 %
Change in co-workers	202	49.5 %
Change in immediate supervisor	202	46.0 %

From team post-intervention, there was an increase in mousing time of nearly one hour a day. There was no evident change in deadline frequency or duration of continuous sitting (Table F.2.3).

Table F.2. 3. Change: Pre to Post Intervention

Variables (Continuous)	Potential Range	(Actual Range)	Sample Size (N)	Mean	SD
Pain Intensity	- 100 to +100	- 58.33 to +83.33	200	0.13	24.85
Keyboarding Time	- 8 to + 8 hrs	- 5 to + 7.5 hrs	189	0.26	2.02
Mouse Time	- 8 to + 8 hrs	- 5 to + 7 hrs	179	0.99	2.02
Telephone Time	- 8 to + 8 hrs	- 7 to + 7 hrs	188	0.10	2.02
Decision Authority	- 8 to + 8	- 4 to + 4	196	0.05	1.49
Social Support	- 12 to + 12	- 7 to + 8	194	0.03	2.41
Psychological Demands	- 8 to + 8	- 4 to + 5	199	-0.09	1.58
Skill Discretion	- 12 to + 12	- 8 to + 7	193	0.12	2.07

Variables (Categorical)	Sample Size (N)	
Frequency of Deadlines	N = 187	
- More Frequent Deadlines		11.8 %
- No Change		79.1 %
- Less Frequent Deadline		9.1 %
Sitting Continuously	N = 203	
- Sitting for Shorter Periods		19.2 %
- No Change		62.1 %
- Sitting for Longer Periods		18.7 %

Preliminary regressions provided possible predictors of the change in pain. Three regressions were run that produced no retained variables; these included independent variables of pre-intervention questions, post-intervention equipment changes and post-intervention computer changes. The significant variables from the preliminary models were: service area contracted out during the past three years, change in keyboard time, change in telephone time, post-intervention mousing time and gender (Table F.2.4 (a-g)).

Table F.2. 4a. Preliminary Regression (Dependent Variable: **Change in Pain Intensity Score,** Independent Variables: **Selected Pre-Intervention Questions)**

Variable	Coefficient	Standard Error	F-Value	Pr > F
Intercept	-6.52993	21.75603	0.09	0.7645
Gender	-1.14179	4.88921	0.05	0.8157
Frequency of Deadlines	-2.37658	5.16466	0.21	0.6460
Sitting Continuously	2.41007	3.25772	0.55	0.4605
Keyboard in the Box (Proper Position)	0.18829	4.56617	0.00	0.9672
Screen in the Box (Proper Position)	4.16054	4.92649	0.71	0.3997
Age	-0.31636	0.22646	1.95	0.1644
Keyboarding Time	-0.54362	1.30547	.017	0.6777
Mouse Usage Time	1.33560	1.05456	1.60	0.2072
Telephone Time	1.10425	1.15644	0.91	0.3411
Decision Authority	1.21326	1.43733	0.71	0.3999
Social Support	0.67050	1.11275	0.36	0.5477

Psychological Demands	0.01054	1.68415	0.00	0.9950
Skill Discretion	-0.20429	1.58724	0.02	0.8978
Team (Part of Reorganization)	-1.3267	5.43450	0.06	0.8023

Table F.2. 4b. Preliminary Regression (Dependent Variable: **Change in Pain Intensity Score,** Independent Variables: **Post-Intervention Equipment Changes Over the Past 3 Years)**

Variable	Coefficient	Standard Error	F-Value	Pr > F
Intercept	0.87546	6.14517	0.02	0.8869
New workstation location	1.15857	6.07233	0.04	0.8489
New workstation	4.2379	5.88668	0.52	0.4725
New chair with armrests	-3.64517	5.48470	0.44	0.5071
Addition of wrist rests	3.23504	3.98221	0.66	0.4176
Addition of document holder	-5.48747	4.15978	1.74	0.1887
Team (Part of Reorganization)	-2.83006	3.70761	0.58	0.4462

Table F.2. 4c. Preliminary Regression (Dependent Variable: **Change in Pain Intensity Score,** Independent Variables: **Post-Intervention Computer Changes Over the Past 3 Years)**

Variable	Coefficient	Standard Error	F-Value	Pr > F
Intercept	5.23015	4.03884	1.68	0.1969
New computer	-0.98873	5.90592	0.03	0.8672
New monitor	4.78168	6.28626	0.58	0.4478
New keyboard	-6.75635	5.30092	1.62	0.2040
Addition of mouse	-4.35989	4.21244	1.07	0.3020
Increased use of mouse	-4.77758	4.61794	1.07	0.3022
Increased use of computer	6.86526	4.81744	2.03	0.1558
New front end system	-2.87533	7.37982	0.15	0.6973
New computer programs	1.67118	4.49757	0.14	0.7106
Team (Part of Reorganization)	-2.47824	3.80462	0.42	0.5156

Table F.2. 4d. Preliminary Regression (Dependent Variable: **Change in Pain Intensity Score,** Independent Variables: **Post-Intervention Job Changes Over the Past 3 Years)**

Variable	Coefficient	Standard Error	F-Value	Pr > F
Intercept	-0.19114	3.82340	0.00	0.9602
Different job title / description	-5.78343	4.11909	1.97	0.1620
Different tasks in same job	3.15862	3.71447	0.72	0.3962
Increased job responsibility	6.04121	4.29705	1.98	0.1614
Decreased job responsibility	12.86367	10.05643	1.64	0.2024
Less variety in job	-4.58194	6.67035	0.47	0.4930
Broader job scope	1.34670	4.53047	0.09	0.7666
Service Area contracted out ****	-25.54892	10.76109	5.64	0.0186
Assigned to a different group / unit	8.14219	5.36777	2.30	0.1310
New Team	-5.62150	5.30197	1.12	0.2904
Change in co-workers	-2.56069	4.11286	0.39	0.5343
Change in immediate supervisor	2.57539	3.94493	0.43	0.5147
Team (Part of Reorganization)	-3.58117	3.70371	0.93	0.3348

**** Denotes that the variable was significant at $p<0.05$.

Table F.2. 4e. Preliminary Regression (Dependent Variable: **Change in Pain Intensity Score,** Independent Variables: **Continuous Pre to Post Difference)**

Variable	Coefficient	Standard Error	F-Value	Pr > F
Intercept	1.22058	3.96631	0.09	0.7588
Difference in Deadlines	-2.11765	4.40979	0.23	0.6319
Difference in Sitting Continuously	1.42790	2.96656	0.23	0.6311
Difference in Keyboarding Time ****	3.00565	1.41906	4.49	0.0360
Difference in Mouse Time	0.14561	1.23627	0.01	0.9064
Difference in Telephone Time ****	-2.49758	1.19921	4.34	0.0392
Difference in Decision Authority	-0.64940	1.54485	0.18	0.6749
Difference in Social Support	0.57776	1.03726	0.31	0.5785
Difference in Psychological Demands	1.65102	1.52510	1.17	0.2810
Difference in Skill Discretion	0.29215	1.22485	0.06	0.8118
Team (Part of Reorganization)	-2.70315	4.73617	0.33	0.5691

**** Denotes that the variable was significant at $p<0.05$

Table F.2. 4f. Preliminary Regression (Dependent Variable: **Change in Pain Intensity Score,** Independent Variables: **Selected Post-Intervention Questions)**

Variable	Coefficient	Standard Error	F-Value	Pr > F
Intercept	-16.30834	21.09658	0.60	0.4410
Gender	-5.13122	5.21856	0.97	0.3274
Frequency of Deadlines	1.84442	4.46739	0.17	0.6804
Sitting Continuously	2.77347	3.31905	0.70	0.4050
Keyboard in the Box (Proper Position)	3.37981	5.33905	0.40	0.5279
Screen in the Box (Proper Position)	-4.13162	5.13277	0.65	0.4224
Age	-0.28165	0.24616	1.22	0.2719
Keyboarding Time	1.06142	1.68330	0.40	0.5295
Mouse Usage Time ****	2.07981	1.24816	2.78	0.0981
Telephone Time	0.29325	1.23837	0.06	0.8132
Decision Authority	2.50287	1.62038	2.39	0.1249
Social Support	0.89568	1.30010	0.47	0.4921
Psychological Demands	1.13078	1.64408	0.47	0.4928
Skill Discretion	-1.65547	1.53044	1.17	0.2815
Team(Part of Reorganization)	3.63055	5.86673	0.38	0.5371

**** Denotes that the variable was significant at $p<0.05$.

Table F.2. 4g. Preliminary Regression (Dependent Variable: **Overall Pain Intensity Score,** Independent Variables: **Selected Post-Intervention Questions)**

Variable	Coefficient	Standard Error	F-Value	Pr > F
Intercept	-28.42959	18.59569	2.34	0.1288
Gender ****	18.32277	4.59610	15.89	0.0001
Frequency of Deadlines	0.94148	3.94425	0.06	0.8117
Sitting Continuously	2.68823	2.91378	0.85	0.3580
Keyboard in the Box (Proper Position)	5.94338	4.66134	1.63	0.2046
Screen in the Box (Proper Position)	-7.27962	4.50523	2.61	0.1086

Age	0.17481	0.21741	0.65	0.4229
Keyboarding Time	-0.02026	1.48104	0.00	0.9891
Mouse Usage Time	1.54997	1.09750	1.99	0.1603
Telephone Time	0.82814	1.09323	0.57	0.4501
Decision Authority	0.64546	1.42568	0.20	0.6515
Social Support	1.07310	1.14562	0.88	0.3507
Psychological Demands	2.12309	1.43290	2.20	0.1409
Skill Discretion	-1.03283	1.34488	0.59	0.4439
Team (Part of Reorganization)	4.83046	5.16140	0.88	0.3511

**** Denotes that the variable was significant at $p<0.05$

The approach to obtaining a final model was as follows: variables were grouped into seven groups. Preliminary multiple regressions were conducted on each using backward elimination of variables (an indicator variable for team/ non-team status was included in each regression). Variables were retained if the p-to-remove was less than 0.05. Retained variables from all seven models were included as candidate variables for the final regression model. Team/non-team status was included in the candidate variables even though it had not proven significant in any preliminary regression. The variables retained in the model were: service area contracted out during the past three years, change in keyboard time, change in telephone time, and post-intervention mousing time (Table F.2.5).

Table F.2. 5. Final Regression (Dependent Variable: Change in Pain Intensity Score, Independent Variables: Significant Variables From the Intermediate Regressions and Pod)

Variable	Coefficient	Standard Error	F-Value	Pr > F
Intercept	-0.48717	4.09457	0.01	0.9221
Gender	-4.49645	0.93457	1.21	0.2738
Mouse Usage Time (Post-Team) ****	1.82645	0.93795	3.79	0.0532
Service Area contracted out ****	-23.77423	10.85691	4.8	0.0300
Difference in Keyboarding Time ****	1.92624	1.10845	3.02	0.0842
Difference in Telephone Time ****	-2.32708	1.02212	5.18	0.0241
Team (Part of Reorganization)	-1.35355	3.79835	0.13	0.7220

**** Denotes that the variable was significant at $p<0.05$.

Discussion

Few of the variables we studied showed any significant effect on reported levels of pain. This was surprising, as we had expected that movement into teams would have had an important effect. Informal information collected while contacting workers during the intensive exposure component of the study (see section F.1 above) and formal interviews with those in teams and not in teams (see section G3) suggested that in practice employees' jobs had changed little. This likely explains the lack of differences between team and non-team workers.

As for the other variables, their lack of effect on pain cannot be readily explained. The variables we examined showed a range of values, in particular, changes in them were both positive and negative, and were not clustered closely around zero (no change). Notably, the variable that showed the greatest change, time using mouse, was significant in the final model. So, too, was whether there had been contracting out from that service area with a <u>decrease</u> in pain when this occurred. Only 3% of our sample, however, reported such contracting out.

With 203 respondents, power was likely not a concern, confirmed by the standard errors of the coefficients, which are typically not large. It is the "effect" sizes themselves that are small.

G.1 REPEAT CROSS-SECTIONAL SURVEY

G.1.1 Methods

Populations

Although the RSI program applied to the entire workforce, the repeat cross-sectional study component focused on office workers employed at the head office, at zone offices and at external bureaus, as these were the areas included in the 1996 (Phase I) workforce survey i.e. the printing plant and other company operations were excluded in the listing of employees obtained from The Star. Similarly excluded were non-permanent employees at the request of the RSI Committee members. An article about the questionnaire appeared in the employee newspaper over the summer of 2000 and a reminder with a request to complete the questionnaire was attached to pay stubs closest to the time when the questionnaire was to be distributed in September, 2000. The RSI Committee recruited volunteers to distribute and collect the questionnaires, and training sessions conducted by Institute research staff were held at The Star a week before the questionnaire distribution.

The volunteers distributed 1186 surveys in late September and arranged collection of the returned questionnaires sealed in envelopes by the respondents for reasons of confidentiality. The sealed envelopes were transferred to the research team for coding, data entry and analysis. A participant identification number, assigned during the first phase of the study, was used in order to link responses from the two studies. For new members of the workforce, a new identification number was assigned.

Initial response was not as high as desired (63%). Discussion with the RSI Committee in late November resulted in agreement that a follow up questionnaire could be mailed directly (using their work address) to those employees who had not returned their original questionnaire in an effort to increase the response rate. In late January of 2001, the follow up questionnaire was mailed to this group along with a stamped envelope addressed to the Institute. Additional responses were obtained, increasing the proportion to 69% of those targeted.

Measures

We catalogued the nature and source of all questions used in questionnaire work with the workforce since our initial cross-sectional survey of March 1996, i.e., including Phase 2 intensive work in 1997, the pre-team questionnaire in 1998 (see section F above) and treatment monitoring (see section E.2 above). In addition, RSI Committee members suggested questions of interest to them. Domains were grouped by sections including: A demographic; B knowledge, attitudes and practices relevant to RSI/WMSD and participation in and assessment of the Ergonomic Policy implementation; C updated job title and departmental affiliations, postural factors (e.g., screen position, keyboard position and mouse position) and task demands (e.g., deadlines, synchronization of work with others); D psychological demands, skill discretion and workplace social support using the abbreviated Job Content Questionnaire; E role ambiguity; F resource control and perceptions of management approaches; G symptom occurrence, intensity and impacts, health care sought, and reports to the workplace; H upper extremity disability and work difficulty using the DASH; and I reported work interference (see appendix V) for copy of questionnaire).

Analyses

Aggregate

Broad (i.e. workplace wide and department wide) changes in prevalence of key outcome measures were described using pre- and post-intervention frequency distributions. Since the goal of the intervention was to reduce the overall impact of WMSD in the workforce, it was appropriate to look at aggregate change, as a reflection of the overall impact of implementation of the Ergonomic Policy. Given there were a subset of subjects with data at both points in time, the pre- and post-intervention samples were not independent. To develop test statistics which accounted for this lack of independence, suppose n_{12} subjects respond to both surveys, n_1 subjects respond just to survey 1 and n_2 subjects respond just to survey 2. Then, there will be paired data for n_{12} subjects. For a given outcome variable Y, with means **y bar**$_1$ and y bar $_2$ at surveys 1 and 2 respectively, let y_{ij} represent measures for subject i at time point j. The sample mean from surveys 1 and 2 are denoted y bar sub 1 and y bar sub 2 respectively. Then Δ = y bar sub 1 - y bar sub 2 can be used to assess change between surveys. The variance of Δy is $\sigma^2 = (n_2 n_{12} + n_1 n_{12} + 2n_1 n_2 - 2n_1 n_2 \square) \sigma^2 / (n_1 n_2 n_{12})$, where σ^2 is the variance of Y (assumed equal at survey 1 and survey 2) and ρ is the correlation between measures of Y taken on the same subject at both surveys. Then Δ/s will provide a test statistic, where s is the square root of the sample estimate of σ^2. For the proposed outcome measures, Y may be dichotomous or continuous. Given the large sample sizes which should be available, a normal distribution for is assumed here.

Cohort

To better understand potential reasons for the aggregate changes, we also focused on the 433 employees who responded to both the 1996 survey (P1) and the repeat 2000/2001 survey (Q4). We examined characteristics of this P1Q4 cohort in relation to all P1 respondents to assess selection biases into the cohort. Within the cohort, we were particularly interested in relationships between P1 health status, participation, concomitant work changes, changes in risk factors for WMSD and Q4 health status as in Figure G.1.1

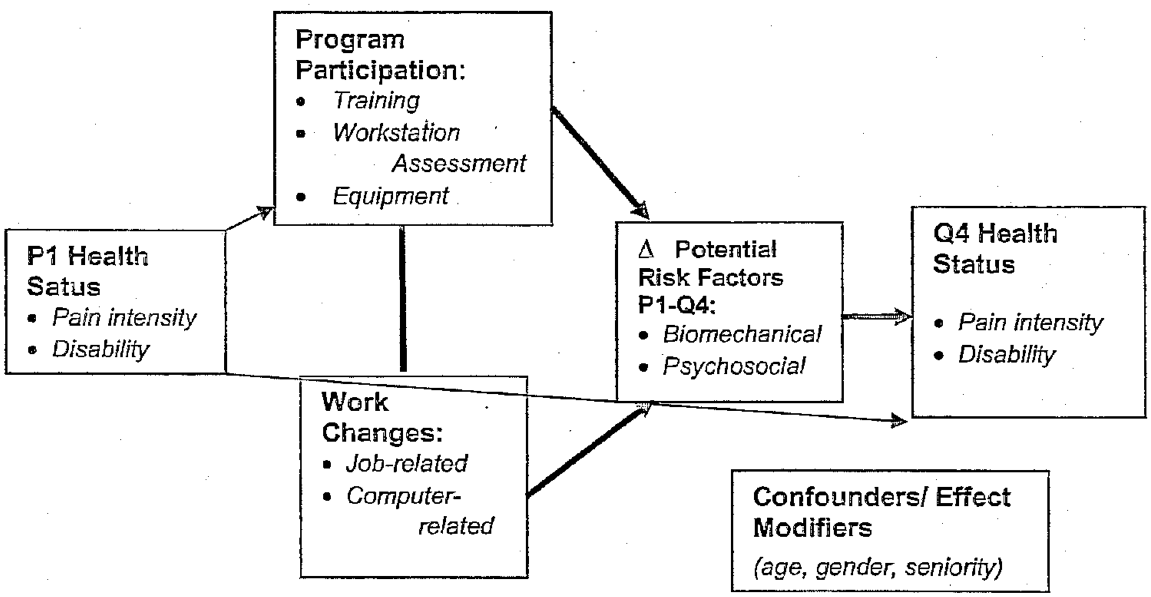


Figure G.1.1: Model for analyzing change between P1 (1996) and Q4 (2001)

Relationships between baseline health status variables i.e., pain intensity, upper extremity disability and work difficulty and indicators of individual participation in Ergonomics Policy implementation activities i.e., training sessions, workstation assessments and new equipment, allowed us to examine selective application of the intervention within the workforce. Unpaired t-tests for continuous variables and chi-square for dichotomous and ordinal variables were used.

Changes in potential risk factors for WMSD between P1 and Q4 were constructed differently for continuous and ordinal variables. For single item ordinal variables, cross-tabulations were conducted. If the symmetry test was not significant ($p > 0.15$) then the variable was dropped from further analyses e.g. health and safety treated as important as productivity (check wording). If significant then change variables were constructed such that increases in potential risk factors for WMSD were valued as +1 in keeping with likelihood of increasing pain or disability over time, 0 as neutral and -1 if likely to reduce pain or disability over time. For continuous variables, difference scores (Q4 - P1) were calculated. Associations among change variables in a particular domain were examined via cross-tabulations for ordinal (with symmetry tests) and correlations for continuous variables. Using such methods we were able to reduce the number of potential explanatory variables at each stage.

Next, we explored relationships between blocks of variables along the hypothesized paths to elucidate the changes occurring in the cohort, including associations with potential confounders/effect modifers i.e., age, gender and seniority. We started with the bivariate relationships between participation, work change, and changes in potential WMSD risk factors. Then we examined bivariate relationships between these changes in potential WMSD risk factors and Q4 health status measures, taking into account P1 health status variables. On the basis of these analyses, we were able to reduce the number of variables going into multivariate models by focusing on variables significant at $p<0.2$.

We wanted to deal with the skewness of the health status variable distributions in order to promote better fits in multivariate models. We therefore re-categorized the health variables into 3 levels ordinal for pain intensity and *Quick*DASH disability, based on approximate tercile cutpoints, and work disability to a dichotomous outcome, given that 70% of q4 values had a 0 value. The multivariate polytomous and logistic models were done sequentially backwards from Q4 health status following the conceptual model above (Figure G.1) i.e. change in potential risk factors as predictors of Q4 health status first, program participation and work change variables as predictors of identified (reduced number) of risk factors next, and finally P1 health status as a predictor of program participation and work change variables. Model reductions were achieved by manually removing those with the highest p value until all remaining variables in each model had a p value of <0.2. Although we sometimes noted changes in variable coefficients through this process, sample size restrictions prevented us from carrying forward all potentially relevant variables to the next stage of path modeling.

Having completed the sequential work and variable reduction, we next constructed path analyses from P1 health status, through participation and work changes, through risk factor changes, and on to health status at Q4. We further reduced these path models by sequentially removing variables whose z score was <1.6, roughly equivalent to $p=0.1$.

G.1.2 Results & Discussion

Aggregate analyses

As a whole the survey respondent population was somewhat older at Q4 than P1 and included proportionately more women (see table G.1.1). More were permanent employees in keeping with the sampling frame advocated by the RSI committee. Tenure was somewhat reduced, in keeping with the contracting out that the company engaged in.

Table G.1.1 Population characteristics: mean (standard deviation) (low, high) n

Domain	Variables	1996 P1 n=1007	2001 Q4 n=813	Δ, p, Confidence Interval & interpretation
B Demo-graphic	Age (years)	42.1(9.3) (18,65) n=938	42.9 (10.1) (20,64) n=805	Δ=0.84 p=0.0284 CI (0.09, 1.59) Q4 significantly older
	Sex F M invalid/ missing	444 (44%) 544 (54%) 19 (2%)	434 (53%) 379 (47%) - (-)	Δ =0.08 p < 0.0001 CI (0.05, 0.12) Q4 significantly smaller proportion male, could be non-response bias, or reflect the changing composition of the workforce (circulation outsourced)
	Marital Status	M/CL 698(69%) Single 162 (16%) D/S/W 109 (11%) invalid/missing 38 (4%)	M/CL 522 (64%) Single 157 (19%) D/S/W 85 (11%) invalid/missing 49 (6%)	Similar
Work	Tenure (years)	15.9 (8.8) Range (0,51) n=981	15.0 (11.0) Range(0,46) n=795	Δ =-0.82 p= 0.0378 CI (-1.60, -0.05) Q4 significant shorter tenure at Star (around 9 months) consistent with layoffs of workers
	Work Status: FT/Perm PT Perm Temporary/ contract Invalid/ missing	 756 (75%) 216 (21%) 26 (3%) 7 (1%)	 707 (87%) 99 (12%) - 7 (1%)	FT/Perm(0) vs. PT/Perm(1) Δ =-0.10 p <0.0001 CI (- .13, -.07) At Q4, significantly more FT/Perm status, consistent with distribution only to FT/PT employees at Q4 Note that <5 on disability at P1

The departmental distributions showed far fewer circulation employees (37 to 13%) consistent with layoffs/contracting out, and corresponding increases in advertising (18 to 24%) and editorial (28 to 32%).

The majority of Q4 respondents reported participating in the 1998 Stop RSI Training Program (Y 469 (58%), N 310 (38%), invalid/missing 34 (4%)) or having RSI Training part of Orientation (Y 91 (11%), N 232 (29%), invalid/missing 490 (60%)). Heartening changes were seen in the significantly increased endorsement of many relevant response options as to potential causes of RSI/WMSD: workstation, tools, breaks, keyboarding, workload, exercise, posture, etc. (see table G.1.2). At the same time "lack of training" was mentioned less frequently.

Table G.1.2 Perception of causes of RSI/WMSD

Measure	1996 P1 n=1007	2001 Q4 n=813	Δ, p, Confidence Interval & interpretation
Perceptions of Cause of RSI			
1 Poorly Designed Workstation	684 (68%)	635 (78%)	Δ =0.12, p<0.001 CI (0.08,0.16)
2 Poorly Designed Tools	337 (33%)	317 (39%)	Δ =0.06, p=.0038 CI (0.02, 0.11)
3 Lack of Personal Protective	***(not offered)***	120 (15%)	
Equipment	***(not offered)***	291 (36%)	
4 Bad Physical Environment	149 (15%)	123 (15%)	Δ =0.006,p=.703 CI (-0.03, 0.04)
Conditions	548 (54%)	502 (62%)	Δ =0.09, p<0.001 CI (0.04, 0.13)
5 Tasks requiring lot force	***(not offered)***	445 (55%)	
6 Too much keyboarding	***(not offered)***	420 (52%)	
7 Too much mousing	748 (74%)	***(not offered)***	
8a Lack of Task Variability	177 (18%)	209 (26%)	Δ =0.09, p<0.001 CI (0.05, 0.12)
8b Jobs with Repetition	407 (40%)	421 (52%)	Δ =0.12, p<0.001 CI (0.08, 0.17)
9 Deadlines	270 (27%)	329 (40%)	Δ =0.15, p<0.001 CI (0.11, 0.19)
10 Working without Breaks	***(not offered)***	114 (14%)	
11 Excessive Workload	***(not offered)***	47 (6%)	
12 Little Job Control	97 (10%)	74 (9%)	Δ =-.002, p=0.869 CI (-0.03, 0.02)
13 Low Job Responsibility	***(not offered)***	60 (7%)	
14 Conflicts at Work	405 (40%)	292 (36%)	Δ=-0.03, p=0.109 CI (-0.08, 0.008)
15 Little Social Support	345 (34%)	374 (46%)	Δ=0.13, p<0.001 CI (0.08, 0.17)
16 Too Much Stress	370 (37%)	189 (23%)	Δ=-0.13, p<0.001 CI (-0.17, -0.09)
17 Lack of Exercise	684 (68%)	595 (73%)	Δ=0.07, p=0.0011 CI (0.03, 0.11)
18 Lack of Training	99 (10%)	108 (13%)	Δ=0.04, p=0.0099 CI (0.01, 0.07)
19 Poor Posture	231 (23%)	262 (32%)	Δ=0.10, p<0.001 CI (0.06, 0.14)
20 Personality Type	167 (17%)	162 (20%)	Δ=0.04, p=0.028 CI (0.004, 0.07)
21 Previous Injury	176 (18%)	***(not offered)***	
22 Previous Medical Problem	-	26 (3%)	
23 Way Job Has to be Done	49 (5%)	16 (2%)	
24 Other			
invalid/missing			

Perceptions of management support for RSI at the Star also improved (table G.1.3). Respondents indicated little change in the extent to which their direct supervisors were aware and concerned about RSI, indicating a potential lack of penetration of the kind of cultural shift that the RSI Program wanted to bring about. On the other hand, social support at work more generally, increased.

Table G.1.3 Support

Measure	1996 P1 n=1007	2001 Q4 n=813	Δ, p, Confidence Interval & interpretation
Management supportive re: RSI strongly agree agree neither disagree strongly disagree invalid/missing	197 (20%) 443 (44%) 270 (27%) 47 (5%) 12 (1%) 38 (3%)	196 (24%) 403 (50%) 160 (20%) 33 (4%) 9 (1%) 12 (1%)	(strongly agree, agree(1)) vs. others Δ =0.09, $p < 0.0001$, CI (0.05, 0.13) Q4 significantly greater agreement - ?reflection of what workers ***observe***, e.g., in-house PT, training , workstation assessments , Star Beat etc.
Supervisor aware and concerned re: RSI strongly agree agree neither disagree strongly disagree invalid/missing	156 (15%) 421 (42%) 295 (29%) 67 (7%) 24 (2%) 44 (4%)	109 (13%) 359 (44%) 246 (30%) 74 (9%) 16 (2%) 9 (1%)	(strongly agree, agree) vs. others Δ =-0.02 p=0.4530 CI (-0.06, 0.03) no significant change - reflects what workers ***experience*** with direct supervisor
Social Support at work (JCQ, 0-12, higher scores more support)	7.8 (2.1) Range (0,12) n=977	8.0 (2.0) Range (1,12) n=788	Δ=0.28 p= 0.0020 CI (0.10, 0.45) Q4 significantly higher social support

Yet other workplace organization factors showed no change i.e., the frequency with which health and safety was considered as important as productivity, the frequency with which workers take part in decisions, and the intensity of agreement that employees ideas were listened to by management.

At the job level, most work organization measures showed little aggregate change: decision latitude (higher scores mean higher latitude) showed no aggregate change (P1 mean 12.1 (SD3.5) Range (0,20) n=972; Q4 12.0 (3.1) Range (0,20) n=778; □=-0.07 p= 0.6145 95% CI (-0.34, 0.20)) Psychological Workload Δ (based on 2 items, high scores mean lower psych demands) (P1 5.3 (1.6) Range(0,8) n=981; Q4 5.4 (1.5) Range (0,8) n=795; Δ =0.11 p= 0.0892 95% CI (-0.02, 0.24))

On the other hand, a number of task characteristics that could present risks for RSI/WMSD showed important increases in prevalence between surveys: sitting continuously, and time keyboarding particularly (Table G.1.4). These changes were consistent with and aggregate increase in continuous desk work and time on different desk oriented tasks.

Table G.1.4 Task variables

Measure	1996 P1 n=1007	2001 Q4 n=813	Δ, p, Confidence Interval & interpretation
Sitting Continuously < 0.5 hrs 0.5-1 hrs 1-2 hrs > 2 hrs invalid/missing	121 (12%) 301 (30%) 318 (32%) 239 (24%) 28 (3%)	68 (8%) 204 (25%) 260 (32%) 270 (33%) 11 (1%)	> 2 vs < 2 Δ =0.09 p < 0.0001 CI (0.05, 0.13) Q4, significantly more people (9%) sitting for longer than 2 hours (disappearance of 'circ'?, increase in desk based work?, more use of web)
Time keyboarding (hrs/day)	3.1 (2.2) Range (0.0,10) n=968	3.8 (2.1) Range (0,12) n=749	Δ =0.66 p <0.0001 CI (0.48, 0.85) Q4, significantly more (~ 40 min/day)
Time mousing (hrs/day) including mouse and non-mouse users	0.7 (1.5) Range(0.0,8.75) N=983	3.0 (2.3) Range (0,12) n=717	Δ =2.28 p<0.0001 CI (2.11, 2.45) significantly more time spent mousing per day (~ 2 hrs/day), due to both increased proportion using mouse and longer time on mouse
Time on phone (hrs/day)	2.4 (2.1) Range (0.0,8.5) n=971	2.6 (2.2) Range (0,12) n=708	Δ =0.29 p=.0014 CI (0.11, 0.46) Q4, significantly more time telephoning per day (~ 20 min)

Workstation setups showed a mix of changes, some reducing potential risks e.g., keyboard inside the box or telephone head set use (see Table G.1.5).

Table G.1.5 Workstation equipment location & type

Measure	1996 P1 n=1007	2001 Q4 n=813	Δ, p, Confidence Interval & interpretation
Screen/monitor in box Inside Outside Not Use/missing	 721 (71.6%) 206 (20.5%) 80 (8.0%)	 574 (71%) 185 (23%) 54 (6%)	Δ =-0.02 p= 0.2884 CI (-0.06, 0.02) no significant change, majority of outside at Q4 were higher than recommended
Keyboard in box Inside Outside Not Use/Missing	 564 (56%) 370 (37%) 73 (7.3%)	 585 (72%) 203 (25%) 28 (3%)	Δ =0.14 p= <0.0001 CI (0.10, 0.18) Q4, larger % inside box
Mouse in box Inside Outside Not use/missing	 163 (16.7%) 200 (19.9%) 644 (64%)	 498 (61%) 247 (30%) 68 (8%)	Δ =0.22 p <0.0001 CI (0.16, 0.28) Q4, significantly larger % inside box (larger # at Q4 with mouse

			outside box, BUT of mouse users at Q4, majority have mouse in good position)
Telephone type Hand Held	739 (73%)	546 (67%)	Δ =-0.04 p=.0290
Head Set	264 (26%)	281 (35%)	Δ =0.09 p<0.0001
Cellular	190 (19%)	125 (15%)	Δ =-0.02 p=.2422
Shoulder Rest	25 (2%)	6 (1%)	Δ =-0.02 p=.0037
Hands Free	76 (8%)	48 (6%)	Δ =-0.01 p=.2123
Do Not Use	7 (0.7%)	21 (3%)	Δ =0.02 p=.0009
Invalid/missing	47 (5%)	24 (3%)	Q4, significant increase in head set use but decrease in hand held & shoulder rest

Overall, the prevalence of pain and discomfort during the past year increased (table G.1.6). The vast majority said that their symptoms were caused or aggravated by work (Yes 308 (57%), to some extent 183 (34%), No 54 (10%), invalid/missing 18). However, there was a significant decrease in prevalence of those with the more severe NIOSH case definition from 20% to 16%. This definition required that workers had report moderate, severe or unbearable pain or discomfort either once per month, or for longer than one week duration over the last year. Further they had to have no history of previous trauma to that area.

Table G.1.6 Pain and discomfort among all respondents

Measure	1996 P1 n=1007	2001 Q4 n=813	Δ, p, Confidence Interval & interpretation
Pain/discomfort, past year Yes No Missing/invalid	595 (59%) 391 (39%) 21 (2%)	556 (68%) 250 (31%) 7 (1%)	Δ =0.09 p< 0.0001 CI (0.05, 0.13) Q4, significantly more people reporting pain in last year
Pain Intensity Grade (ranges from 0 to 100, 100 is high) (0 imputed for those without pain)	25.5 (26.1) Range (0, 100) n=1007	26.1 (22.6) Range (0,83.3) n=804 invalid/missing 9	Δ =0.61 p= 0.5509 CI (-1.39, 2.60) not significantly different
WMSD Case (NIOSH) Yes No invalid/missing	205 (20%) 798 (80%) 4 (0.4%)	127 (16%) 663 (82%) 23 (3%)	Δ = -0.04 p= 0.0111 CI (-0.08. -0.01) slight decrease in NIOSH cases

As can be seen in table G.1.7, the reduction in workforce WMSD severity seems to have been due to a combination of decreased frequency and duration of episodes and an increase in history of trauma. The increase in work-related disability among those with pain may be due to greater awareness of impact, but other potential causes such as increased task demands seen above are also of concern.

Table G.1.7 Characteristics of pain and associated disability

Measure	1996 P1	2001 Q4	Δ, p, Confidence Interval & interpretation
Symptoms – frequency of episodes Constant Daily 1 / Week 1 / Month Every 2-3 Months Every 6 Months invalid/missing	55 (10%) 86 (16%) 175 (32%) 141 (26%) 73 (13%) 12 (2%) 74	31 (6%) 69 (13%) 168 (31%) 135 (25%) 94 (17%) 52 (9%) 14	Δ=-0.1091 p<0.0001 CI (-0.16, -0.06) Q4 decreased frequency of episodes contributed to decreased burden (comparing less frequent than 1/Month to as or more frequent than 1/Month)
Symptoms - length episodes < 1 Hour 1 Hour - 1 Day 1 Day - 1 Wk 1 Wk - 1 Month 1 - 6 Months > 6 Months invalid/missing	92 (18%) 181 (36%) 123 (24%) 45 (9%) 16 (3%) 51 (10%) 108	96 (18%) 218 (41%) 124 (23%) 33 (6%) 30 (6%) 31 (6%) 31	Δ=0.04 p=0.0645 CI (-0.003, 0.09) Very small shift towards shorter episodes (4% more likely in Q4), but the result is marginally significant. Comparing episode of no more than 1 week to episodes of a week or more
Symptoms - Prior Trauma Yes No invalid/missing	92 (15%) 524 (85%) --	112 (21%) 434 (79%) 17	Δ=0.05 p=0.0158 CI (0.01, 0.09) Q4, slight ↑ in proportion with previous trauma
Locations of Pain Neck Shoulder Elbow/Forearm Wrist/Hand invalid/ missing	379 (63%) 323 (54%) 221 (37%) 380 (63%) 16	405(75%) 328(61%) 192 (36%) 308 (57%) 23	Δ=0.12 p <.0001 Δ=0.07 p=.0122 Δ=-0.01 p=.6365 Δ=-0.06 p=.0202 Q4 significant increases in Neck, Shoulder and decrease in Wrist/Hand at Q4
Disabilities of the Arm /Shoulder/Hand *Quick*DASH Mean (SD), higher more disability invalid/missing	14.2 (14.5) Range (0,88.6) n=471 145	14.7 (14.5) Range (0,84.1) n=540 23	Δ=0.46 p= 0.5590 CI (-1.08, 2.0) not significantly different
*Quick*DASH work module Mean (SD), higher more disability invalid/missing	7.9 (15.1) Range (0,83.3) n=578 38	10.1 (16.5) Range (0,100) n=534 29	Δ=2.21 p= 0.0105 CI (0.52, 3.90) Q4, significantly higher work related disability

In response to their pain, the vast majority did something (49%) including: exercises n=259 (65%), changing posture n=237 (59%), self education n=151 (38%), heat or ice n= 148 (37%), relaxation n=122 (31%), adjusting their workstation n=116 (29%), medication n=92 (23%) and a range of other less frequent options (changed job description 10 (3%), splints/braces 37 (9%), injections 7 (2%), surgery 7 (2%) and other 36 (9%)). At Q4 they were more likely to see a health care practitioner, likely reflecting the availability of on-site physiotherapy (table G.1.8). Further, they were somewhat more likely to report their symptoms to the workplace (though not significantly so at $p<0.1$), in keeping with the RSI Committee's work to increase reporting through emphasis in RSI training sessions and through posters on bulletin boards in the workplace. The most common practitioners seen were: family physician (42%) and physio on-site at The Star (37%).

Table G.1.8 Responses to pain

Measure	1996 P1	2001 Q4	Δ, p, Confidence Interval & interpretation
Consulted a health care practitioner Yes No invalid/missing	 271 (46%) 324 (54%) 26	 316 (57%) 240 (43%)	Δ=0.11 p<= 0.0001 CI (0.06, 0.17) significantly more (11% more of those reporting pain) consulting health care practitioner at Q4 – perhaps related to more readily accessible access e.g., on-site physiotherapy
Symptoms reported to workplace Yes No invalid/missing	 216 (36%) 379 (64%) 21	 217 (40%) 327 (60%) 19	Δ=0.04 p= 0.1791 CI (-0.02, 0.09) reporting proportion not significantly different

Cohort Analyses

Description of Populations

The cohort population was understandably older than at P1 and by Q4 had greater seniority than other Q4 participants (table G.1.9)

Table G.1.9 Newspaper employees participating in repeat cross-sectional surveys before and after implementation of the RSI Program

Characteristics	P1 - 1996		Q4 - 2001-2	
	All participants (n=1003)	Cohort (n=433)	All participants (n=813)	Cohort (n=433)
Demographic				
Age	42.1 (9.3)	41.1 (8.1)	42.9 (10.1)	46.2 (8.2)
Gender: Male	546 (55.7)	177 (41.7)	379 (46.6)	175 (40.4)
Female	434 (44.3)	248 (58.3)	434 (53.4)	258 (59.6)
Work Factors				
Seniority	15.8 (8.8)	15.7 (8.0)	14.9 (11.0)	20.4 (7.9)
Departments: Advertising	178 (17.7)	115 (26.6)	192 (23.6)	126 (29.1)
Circulation	371 (37.0)	85 (19.6)	109 (13.4)	67 (15.5)
Communications	15 (1.5)	9 (2.1)	18 (2.2)	7 (1.6)
Corp. Systems & Digital Media	60 (6.0)	30 (6.9)	67 (8.2)	28 (6.5)
Editorial	278 (27.7)	143 (33.0)	261 (32.1)	146 (33.7)
Finance & Administration	64 (6.4)	35 (8.1)	60 (7.4)	39 (9.0)
HR/Labour Relations	23 (2.3)	12 (2.8)	23 (2.8)	7 (1.6)
Marketing Research	5 (0.5)	2 (0.5)	11 (1.4)	2 (0.5)
Prepress	0 (0.0)	0 (0.0)	67 (8.2)	7 (1.6)
Other	10 (1.0)	2 (0.5)	5 (0.6)	4 (0.9)
Work Status:				
Full-time, permanent	756 (75.6)	355 (82.4)	707 (87.7)	394 (91.6)
Part-time, permanent	216 (21.6)	70 (16.2)	99 (12.3)	36 (8.4)
Temporary	18 (1.8)	5 (1.2)		
Contract	8 (0.8)	1 (0.2)		
On Disability	2 (0.2)	0 (0.0)		

* differences in proportions or means across groups at *same* time i.e. selection
† differences in proportions or means in the cohort *across* times i.e. different

Selection/Attrition for Cohort

When examining potential selection biases into the cohort or alternatively selective attrition in the P1 participants over time, one can observe a number of differences between cohort members and those that only participated in P1 on both key potential risk factors for WMSD and on health status.

Among the potential risk factors, cohort members were less likely to report that their supervisor was aware and concerned about RSI, but more likely to think that employees' ideas were listened to and that workers often took part in decisions. Interestingly, their reported psychological job demands were higher and their job security lower. They also spent more time keyboarding and using the telephone at P1.

Table G.1.10 Potential selection into cohort on key potential risk factors for WMSD measured at P1

Measure	P1Q4 cohort members n=433	P1 participation only n= 574	Difference & significance
Support			
Mgt support re RSI strongly	96 (22%)	101 (17%)	0.07, overall
agree	198 (46%)	245 (44%)	p=0.03 with Chi-
agree	102 (24%)	168 (29%)	Square
neither	19 (4%)	28 (5%)	cohort more likely
disagree	9 (2%)	3 (0 %)	in agreement
strongly disagree	9 (2%)	29 (5%)	
invalid/missing			
Supervisor aware & concerned re	80 (18%)	76 (13%)	
RSI strongly	192 (44%)	229 (41%)	0.08, overall
agree	112 (26%)	184 (32%)	p=0.06 with Chi-
agree	28 (6%)	39 (7%)	Square, cohort
neither	10 (2%)	14 (2%)	more likely in
disagree	12 (3%)	32 (5%)	agreement
strongly disagree			
invalid/missing	7.7 (2.1) n=421	7.8 (2.1) n=556	
Social support at work			-0.1(2.1) p=0.5

Workplace Organization			
Employees ideas listened to by management Strongly Disagree	20 (5%)	25 (4%)	-0.03, overall p=0.05 cohort less likely to be in agreement
Disagree	84 (19%)	72 (12%)	
Neither	142 (33%)	204 (35%)	
Agree	161 (37%)	219 (38%)	
Strongly Agree	23 (5%)	42 (7%)	
invalid/missing	3 (1%)	12 (2%)	
Frequency workers take part in decisions Often	81(19%)	134 (24%)	-0.03, overall p=0.18, cohort tended to state sometimes or often less frequently
Sometimes	197(46%)	254 (44%)	
Rarely	110(25%)	120 (21%)	
Never	39(9%)	46 (8%)	
invalid/missing	14(3%)	20 (3%)	
Job Characteristics			
Decision latitude	12.1(3.7) n=424	12.1(3.5) n=548	0.1 (3.6) p=0.7
Psychological demands	5.5 (1.6) n=426	5.1 (1.5) n=555	0.5 (1.6) p<0.0001
Job security good			
Strongly Disagree	25 (6%)	53(9%)	similar proportion agree but -0.06, cohort disagrees less, overall p=0.01
Disagree	53 (12%)	88 (15%)	
Neither	143 (33%)	208 (37%)	
Agree	175 (40%)	172 (30%)	
Strongly Agree	29 (7%)	34 (6%)	
invalid/missing	8 (2%)	19 (3%)	
Physical effort Strongly Disagree	71 (16%)	83 (14%)	similar proportions, overall p=0.49
Disagree	206 (48%)	290 (51%)	
Neither	89 (21%)	123 (21%)	
Agree	51 (12%)	58 (10 %)	
Strongly Agree	13 (3%)	10 (2%)	
invalid/missing	3 (1%)	10 (2%)	
Task			
Sitting continuously < 0.5 hrs	42 (10%)	79 (14%)	Similar proportions, cohort tends to greater proportion >1hour overall p=0.08
0.5-1 hrs	135 (31%)	166 (29%)	
1-2 hrs	151 (35%)	167 (30%)	
> 2 hrs	98 (23%)	141 (25%)	
invalid/missing	7 (2%)	11 (2%)	
Keyboard time (hrs)	3.6 (2.2) n=418	2.7 (2.2) n=550	0.9 (2.2) p<0.0001
Mousing time (hrs)	0.8 (1.6) n=426	0.7 (1.5) n=557	0.1 (1.6) p=0.36
Telephone time (hrs)	2.8 (2.2) n=421	2.0 (1.9) n=550	0.8 (2.0) p<0.0001

Workstation (in box)			
Screen/monitor Inside	315 (73%)	406 (71%)	Similar, p=0.71
Outside	93 (21%)	113 (19%)	
invalid/missing	25 (6%)	55 (10%)	
Keyboard Inside	259 (60%)	305 (54%)	0.06, cohort tends to more inside, p=0.14
Outside	152 (35%)	218 (37%)	
missing	22 (5%)	51 (9%)	
Mouse Inside	67 (15%)	96 (17%)	similar, p=0.80
Outside	89 (21%)	111 (19%)	
Do Not Use	187 (43%)	243 (44%)	
invalid/missing	90 (21%)	124 (20%)	
Telephone Type (multiple response) Hand Held	293 (68%)	446 (78%)	p=0.0004
Head Set	160 (37%)	104 (18%)	p<0.0001
Cellular/Car phone	58(13%)	132 (23%)	p=0.0001
Shoulder Rest	16 (4%)	9 (2%)	p=0.03
Hands Free	39 (7%)	46 (8%)	p=0.5
Do Not Use/ invalid/missing	18 (4%)	36 (6%)	p=0.2

Further, they were more likely to experience musculoskeletal pain in the neck and upper extremities at P1 and higher levels of disability than those who did not continue participation (Table G.1.11.). Hence it appears that rather than a "healthy worker" effect, we have an "unhealthy worker" effect occurring, whereby those with more problems are still at the workplace and continuing to participate.

Table G.1.11. Potential Selection into cohort (or attrition from P1) on health outcomes measured at P1

Measure at P1	P1Q4 cohort members n=433	P1 participation only n= 574	Difference & significance
Symptoms			
Pain/discomfort Yes	294 (68%)	306 (53%)	0.15, p<0.0001 (chi-square)
No	139 (32%)	268 (47%)	
Pain intensity (0 imputed for no pain)	29.8 (26.5) n=433	22.3 (25.4) N=574	7.5 (25.9) p<0.0001
WMSD (NIOSH) case Yes	106 (24%)	99 (17%)	0.07, p=0.004 (chi-square)
No	324 (75%)	474 (83%)	
invalid/missing	3 (1%)	1 (0%)	
Disability			
*Quick*DASH	9.9 (15.1) n=367	6.0 (10.4) n=514	4.0 (12.6) p<0.0001
WorkDASH	6.2 (14.9) n=424	3.4 (9.5) n=567	2.9 (12.1) p=0.0006

Changes for the Cohort (Descriptive and Bivariate Analyses)

Over the years between P1 and Q4, cohort members experienced a number of work changes as well as participating in the program elements (see table G.1.12). Lots of changes in people on the job, job tasks and new computer equipment or software were reported by cohort members. Of note is that some co-variation between these concomitant work changes and program elements is apparent, particularly around new equipment and equipment changes. Hence the importance of documenting co-interventions, common in ever-changing workplaces.

Table G.1.12. Description of Work Changes and Program Participation over last three years (N=428)

Work Changes		Program participation						
		Participation in RSI Training		Workstation Assessment		Equipment Change		
		yes	no	yes	no/ NA	none	new chair only*	n st
Job related (miss=5)	New job/team/workgroup /supervisor Yes = 295	225	57	181	114	**36**	26	3
	No = 133	97	28	80	53	**28**	17	2
	Different tasks, increased job responsibility, broader job scope Yes =273	211	51	164	109	**35**	22	3
	No =155	111	34	97	58	**29**	21	2
Computer related (miss=5)	New computer, monitor or keyboard* Yes = 331	**256**	**59**	207	124	**42**	31	4
	No = 97	**66**	**26**	54	43	**22**	12	1
	Addition of mouse or new computer programs* Yes = 227	**183**	**37**	145	82	**24**	14	2
	No = 201	**139**	**48**	116	85	**40**	29	2
	Increased computer use Yes = 128	97	24	76	52	**14**	12	1
	No = 300	235	61	185	115	**50**	31	3
	Program Totals - pairs of values	324	86	261	172	64	43	5
	missings	23		0				

* Eventually combined into Other change in equipment or programs in multivariate tables.
Bold indicates significant difference across row categories at p<0.15

To explore the pathways of influences on eventual Q4 health status (figure G.1.1) , we needed to examine the extent to which work changes and program participation were associated with changes in relevant exposures that could be potential risk factors for WMSD. No associations were found between participation in RSI training and changes in management or supervisor support re RSI (Table G.1.13a)

Table G.1.13 Associations between Program Participation and Changes in potential risk factors between P1 and Q4

Table G.1.13a . More psychosocial risk factors

Changes in potential Risk Factors from P1 to Q4	Participation in RSI Training	
	yes	no
Management supportive re: RSI		
-1 better = 24	15	6
0 neutral = 375	267	70
+1 persist/worse = 20	15	5
(miss=14)		
Supervisor aware and concerned re: RSI		
-1 better = 28	20	8
0 neutral = 342	260	63
+1 persist/worse = 46	36	9
(miss=17)		

However, those participating in the RSI Training generally spent less time on the telephone (Table G.1.13b). Those having workstation assessments and multiple new equipment had greater increases in mousing time from P1 to Q4. Proportionately more of those receiving new equipment also moved to preferred mouse positions and telephone types by Q4. They also more commonly experienced reductions in physical effort associated with a new chair or workstation.

G.1.13b. More biomechanical risk factors

Changes in Potential Risk Factors	Program participation						
	Participation in RSI Training		Workstation Assessment		Equipment Change: (miss=5)		
	(miss=23)		(miss=100)		none	new chair or work-station	multiple new
	yes	No	yes	no/NA			
Keyboard							
position -1 better	73	25	59	45	16	18	70
(miss=35) 0 neutral	169	36	141	72	26	52	128
+1 persist/worse	60	17	48	33	10	23	44
time spent (hours/day, x	-0.28	-0.26	-0.21	-0.33	-0.06	-0.34	-0.25
(SD))	(2.31)	(1.57)	(2.27)	(2.05)	(2.08)	(2.06)	(2.27)
Mouse							
position -1 better	42	11	38	17	9	**10**	**34**
(miss=100) 0 neutral	134	39	112	70	19	**41**	**119**
+1 persist/worse	71	20	55	41	15	**31**	46
time spent (hours/day, x	1.61	1.31	**1.72**	**1.29**	1.36	1.42	**1.72**
(SD))	(2.24)	(1.80)	**(2.28)**	**(2.02)**	(2.12)	(2.24)	**(2.13)**
Telephone type -1 better	44	12	34	22	5	**11**	**35**
(miss=29) 0 neutral	61	14	50	25	10	**6**	**57**
+1 persist/worse	198	54	160	113	49	**72**	**147**
time spent (hours/day, x	**-0.30**	**0.10**	-0.11	-0.34	-0.22	-0.06	-0.30
(SD))	**(2.09)**	**(2.16)**	(1.90)	(2.40)	(1.71)	(2.02)	(2.22)
Screen position -1 better	41	17	44	20	10	11	43
(miss=52) 0 neutral	180	43	137	93	29	60	135
+1 persist/worse	67	15	55	32	13	21	48
Physical Effort -1 better	33	11	26	19	**2**	**16**	24
(miss=10) 0 neutral	254	68	212	128	**52**	74	206
+1 persist/worse	30	6	19	19	**9**	**9**	18

*bold indicates significant association at p<0.15

Turning to work changes, those cohort members that reported increased job responsibility and broader scope in their jobs over the past three years had increased decision latitude at Q4 compared to P1 but interestingly they also reported greater job insecurity (see table G.1.14a).

Table G.1.14.. Potential Risk factors from P1 to Q4 by Work Changes

G.1.14a. More psychosocial risk factors

Changes in Potential Risk Factors (P1 to Q4)	Job-Related Work Changes			
	New job/team/ workgroup/ supervisor		Different tasks, increased job responsibility, broader scope	
	Yes	No	Yes	No
JCQ - Decision Latitude (ranges from 0 to 20 - higher scores mean higher latitude) (mean, SD)	0.14 (3.13)	-0.07 (3.03)	**0.42** **(3.03)**	**-0.53** **(3.13)**
JCQ -" Psychological Workload" *A* (based on 2 items, ranges from 0 to 8, high scores mean lower psych demands) (mean, SD)	-0.11 (1.80)	-0.30 (1.51)	**0.00** **(1.74)**	**-0.48** **(1.64)**
JCQ - Work Social Support (ranges from 0 to 12 - higher scores mean higher social support) (mean, SD)	0.14 (2.31)	0.38 (2.36)	0.20 (2.33)	0.24 (2.33)
Job Security (missing=14) -1 better = 47	33	14	**30**	**17**
0 neutral =301	202	98	**183**	**117**
+1 persist/worse =71	52	17	**52**	**17**
Worker Empowerment - Employees ideas listened to by management (missing=14) -1 better = 65	47	18	37	28
0 neutral = 274	190	82	176	96
+1 persist/worse = 80	50	28	53	25
Frequency workers take part in decisions (missing=19) -1 better =79	54	23	50	27
0 neutral = 222	156	65	152	69
+1 persist/worse = 113	74	38	63	49

*bold indicates significant association at p<0.15

Reporting of new computer equipment in the last three years was associated with increases in time mousing and, proportionately fewer worse mouse positions, for those adding a mouse (table G.1.14b). Those with greater computer use more commonly reported better telephone equipment such as headsets or hands-free phones.

G.1.14b. More biomechanical risk factors

Changes in exposures potential risk factors between P1 and Q4	Computer-Related Work Changes						(miss) Over-all
	New computer, monitor or keyboard		Addition of mouse or new computer programs		Increased computer use		
	Yes	No	Yes	No	Yes	No	
Keyboard							(35)
position -1 better	80	24	52	52	31	73	104
0 neutral	168	44	122	90	71	141	213
+1 persist/worse	61	19	40	40	20	60	81
time spent (x, (SD) hours/day)	-0.28 (2.26)	-0.12 (1.92)	-0.35 (2.24)	-0.12 (2.11)	-0.23 (2.20)	-0.25 (2.18)	
Mouse							(100)
position -1 better	40	14	**19**	**35**	19	35	55
0 neutral	150	32	**109**	**73**	53	129	182
+1 persist/worse	72	24	**44**	**52**	27	69	96
time spent (x, (SD) hours/day)	**1.68 (2.16)**	**1.22 (2.21)**	**1.97 (2.18)**	**1.11 (2.08)**	1.75 (2.16)	1.49 (2.18)	
Telephone							(29)
type -1 better	37	14	**30**	**21**	**20**	**31**	52
0 neutral	54	20	**50**	**24**	**16**	**58**	75
+1 persist/worse	214	61	**132**	**143**	**83**	**192**	277
time spent (x, (SD) hours/day)	-0.24 (2.09)	-0.08 (2.15)	-0.19 (2.10)	-0.22 (2.10)	-0.17 (1.80)	-0.22 (2.22)	
Screen							(52)
position -1 better	46	18	33	31	19	45	64
0 neutral	182	47	130	99	70	159	230
+1 persist/worse	66	20	41	45	22	64	87
Sitting continuously							(16)
-1 better	35	13	25	23	12	36	48
0 neutral	195	51	136	110	77	169	246
+1 persist/worse	90	33	58	65	34	89	123
Physical Effort							(14)
-1 better	35	9	28	16	10	34	44
0 neutral	259	80	179	160	103	236	339
+1 persist/worse	30	6	17	19	11	25	36

*bold indicates significant association at p<0.15

Yet we also needed to consider potential confounders or effect modifiers. Table G.1.15 a & b show that gender, age and seniority were all associated with some of the changes in exposure or potential risk factors for WMSD. Of particular interest, was that women appeared to experience increases in decision latitude while men and older workers experienced decreases.

Table G.1.15. Changes in potential risk factor for WMSD by potential confounders/effect modifiers

G.1.15a. more psychosocial (*bold - significant at least at p<0.15)

Changes in risk factors	Potential confounders/effect modifiers			
	Gender W	M	Age	Seniority - Star
JCQ - Decision Latitude (mean, SD)	**0.42 (3.20)**	**-0.40 (2.88)**	**r= -0.235** (p<0.001)	**r= -0.195** (p<0.001)
JCQ -" Psychological Workload" (mean, SD)	-0.16 (1.67)	-0.17 (1.78)	r= -0.027	r= -0.047
JCQ - Work Social Support (mean, SD)	0.31 (2.38)	0.07 (2.23)	r= -0.035	**r= 0.106** (p= 0.035)
Job Security -1 better = 47	29	18	**42.9 (8.5)**	**18.0 (8.2)**
(missing=14) 0 neutral=301	179	122	**47.3 (8.0)**	**21.0 (8.1)**
+1 persist/worse =71	40	31	**42.7 (6.9)**	**19.3 (6.0)**
Worker Empowerment - Employees Ideas Listened To	(miss=14)			
-1 better	**46**	**19**	45.4 (8.6)	20.4 (7.5)
0 neutral	**152**	**122**	46.2 (8.3)	20.4 (8.2)
+1 persist/worse	**51**	**29**	46.0 (7.4)	20.3 (7.1)
Frequency workers take part in decisions	(miss=19)			
-1 better	**54**	**25**	**44.3 (9.1)**	19.7 (8.3)
0 neutral	**120**	**102**	**46.3 (8.0)**	20.5 (7.9)
+1 persist/worse	**71**	**42**	**46.5 (7.9)**	20.7 (7.8)
Management supportive re: RSI	(miss=14)			
-1 better	**20**	**4**	45.8 (7.1)	20.4 (7.7)
0 neutral	**225**	**150**	46.1 (8.3)	20.4 (7.9)
+1 persist/worse	**9**	**11**	45.1 (6.9)	20.2 (7.0)
Supervisor aware and concerned re: RSI	(Miss=17)			
-1 better	17	11	44.8 (8.7)	19.0 (7.1)
0 neutral	209	133	46.1 (8.1)	20.6 (8.1)
+1 persist/worse	25	21	45.9 (7.5)	19.9 (6.9)

Similarly, women more commonly obtained better telephones (as did younger workers), reduced their time sitting continuously, and reduced physical effort than men.

G.1.15b. more biomechanical risk factor changes (*bold - significant at least at p<0.15)

Changes in risk factors	Potential confounders/effect modifiers			
	Gender W=258	M=175	Age (range, 28-64)	Seniority - Star (range, 6-46)
Keyboard	(miss 35)			
position -1 better	63	41	45.2 (8.2)	20.4 (7.7)
0 neutral	128	85	46.8 (8.2)	20.5 (7.9)
+1 worse	45	36	45.6 (8.1)	20.5 (8.1)
time spent (x, (SD)	-0.35	-0.12		
hours/day)	(2.22)	(2.12)	r= 0.004	r= 0.010
Mouse	(miss=100)			
position -1 better	37	18	45.1 (7.2)	20.7 (7.5)
0 neutral	109	73	46.1 (8.3)	20.0 (7.9)
+1 worse	62	34	46.0 (8.1)	21.5 (7.9)
time spent (x, (SD)	1.61	1.45		**r= -0.084**
hours/day)	(2.34)	(1.95)	r= -0.057	p=0.09
Telephone	(miss=29)			
type -1 better	**36***	**16**	**44.5 (7.5)**	**18.3 (6.4)**
0 neutral	**66**	**9**	**45.1 (8.3)**	**20.7 (8.2)**
+1 worse	**138**	**139**	**46.9 (8.3)**	**20.9 (8.0)**
time spent (x, (SD)	-0.32	-0.04		
hours/day)	(2.35)	(1.71)	r= -0.002	r= -0.052
Screen position	(miss=52)			
-1 better	39	25	46.0 (8.4)	20.8 (8.2)
0 neutral	141	89	46.5 (8.0)	20.3 (7.7)
+1 worse	47	40	45.4 (8.3)	20.2 (7.7)
Sitting continuously	(miss=13)			
-1 better	**36**	**12**	**43.1 (8.2)**	**18.0 (6.8)**
0 neutral	**141**	**107**	**46.9 (8.4)**	**21.0 (8.2)**
+1 worse	**73**	**51**	**45.9 (7.5)**	**20.2 (7.2)**
Physical Effort	(miss=10)			
-1 better	**24**	**21**	46.5 (8.7)	20.6 (8.7)
0 neutral	**212**	**128**	46.0 (8.0)	20.4 (7.7)
+1 worse	**15**	**23**	45.9 (9.2)	19.7 (7.9)

We also examined change in corrective eyeware as a potential confounder. The vast majority did not change their eyewear (n=292), some improved to multi-focal lenses more appropriate for moving between computer screens and other areas (n=28) but such changes were not associated with changes in screen position, the only relevant change in exposure or potential risk factor variable.

In a preliminary way, we then examined associations between health status changes between P1 and Q4 and these different risk factors and confounders or effect modifiers. Many associations were observed between changes in psychosocial risk factors and health status changes (Table G.1.16).

Table G.1.16. Health status changes from P1 to Q4 by changes in potential risk factors & confounders/effect modifiers

G.1.16b. more psychosocial risk factor changes

Changes in risk factors P1 to Q4	Health Status Changes (mean, SD of P1-q4 difference)		
	Pain intensity	Work-DASH	*Quick*DASH
JCQ - Decision Latitude (mean, SD)	**r= -0.166** (p=0.0008) **p=0.022**	**r= -0.209** (p<0.0001)	**r= -0.157** (p=0.0039) **p=0.028**
JCQ -" Psychological Workload" (mean, SD)	**r= 0.122** (p=0.012) **p=0.105**	**r= 0.130** (p=0.009)	**r= 0.099** (p=0.065)
JCQ - Work Social Support (mean, SD)	r=0.0108	r= -0.064	r= -0.022
Job Security -1 better	**-9.04 (27.79)**	3.90 (13.88)	1.73 (12.94)
0 neutral	**-0.87 (25.07)**	1.64 (17.30)	1.68 (14.04)
+1 persist/worse	**-7.63 (24.18)**	0.26 (17.05)	-2.84 (14.36)
Worker Empowerment - Employees Ideas Listened To -1 better	-6.03 (24.94)	**-2.42 (19.41)**	-0.34 (15.20)
0 neutral	-2.02 (25.57)	**2.00 (15.72)**	1.04 (13.16)
+1 persist/worse	-5.31 (23.99)	**2.96 (17.83)**	0.35 (15.58)
Frequency workers take part in decisions -1 better	-5.70 (30.27)	-1.64 (17.05)	**-2.30 (12.24)**
0 neutral	-3.06 (22.65)	1.72 (15.83)	**-0.64 (13.20)**
+1 persist/worse	-0.96 (26.46)	3.50 (18.71)	**3.50 (16.14)**

Management supportive re: RSI			
-1 better	**-13.89 (25.50)**	**-5.56 (20.36)**	**-4.30 (15.58)**
0 neutral	**-2.29 (25.16)**	**1.83 (15.48)**	**0.79 (13.54)**
+1 persist/worse	**-4.17 (23.80)**	**5.83 (30.60)**	**5.44 (18.11)**
Supervisor aware and concerned re:			
RSI -1 better	-9.52 (25.73)	**-8.63 (20.22)**	**-5.77 (15.55)**
0 neutral	-2.99 (25.24)	**1.71 (15.86)**	**1.10 (13.49)**
+1 persist/worse	1.36 (24.69)	**7.54 (19.72)**	**1.89 (13.99)**

*bold indicates significant at least at p<0.15
^ in model, indicates persistent significance in regression model with baseline value using LR ChiSquare change

Similarly a number of changes in more biomechanical risk factors were found to be associated with health status changes though not always in the expected directions. For example, moves to better keyboard positions were associated with worse disability, perhaps indicating that employees made changes in response to problems. Better telephone types were associated with better general disability but oddly worse work disability. Less physical effort was clearly associated with less work disability, perhaps indicating better match between work demands and capacities.

G.1.16b. more biomechanical risk factor changes

Changes in risk factors P1 to Q4	Health Status Changes (mean, SD)		
	Pain intensity	Work-DASH	*Quick*DASH
Keyboard	(n=398)	(n=380)	(n=330)
position -1 better	-0.40 (23.55)	1.96 (12.54)	**3.69 (12.93)**
0 neutral	-4.13 (26.12)	1.75 (19.23)	**-0.12 (13.80)**
+1 persist/worse	-3.60 (22.44)	0.54 (15.78)	**0.37 (16.45)**
time spent (hours/day)	**r=0.108**	**r=0.152**	**r=0.096**
Mouse	(n=333)	(n=321)	(n=276)
position -1 better	-5.30 (24.29)	-0.63 (20.66)	-1.11 (13.52)
0 neutral	-4.26 (24.68)	2.45 (15.40)	1.44 (12.83)
+1 persist/worse	-3.26 (23.58)	1.28 (17.03)	0.94 (14.11)
time spent (hours/day)	r=0.035	r=0.017	r=-0.014
Telephone	(n=403)	(n=386)	(n=333)
type -1 better	-2.56 (21.80)	**2.89 (18.29)**	**-1.03 (14.02)**
0 neutral	-7.09 (27.92)	**-2.11 (20.15)**	**-2.55 (14.36)**
+1 persist/worse	-1.91 (24.81)	**1.91 (14.61)**	**1.53 (12.78)**
time spent (hours/day)	r=0.020	r=0.013	r=-0.006

Screen position -1 better 0 neutral +1 persist/worse	(n=381) **-6.97 (21.99)** **-0.11 (25.16)** **-6.13 (25.37)**	(n=368) 3.63 (11.84) 1.67 (17.98) 1.18 (17.96)	(n=315) 0.53 (10.26) 1.14 (13.37) 0.95 (18.51)
Sitting continuously -1 better 0 neutral + persist/worse	(n=419) -5.56 (28.21) -3.31 (24.77) -0.61 (24.75)	(n=401) -1.14 (18.64) 1.63 (16.21) 3.16 (17.33)	(n=348) -2.23 (12.61) 1.30 (13.18) 1.77 (16.02)
Physical Effort -1 better 0 neutral +1 persist/worse	(n=423) -2.78 (22.61) -3.52 (26.04) 1.54 (21.82)	(n=405) **-4.27 (20.42)** **2.62 (16.22)** **0.90 (15.19)**	(n=351) 0.39 (13.72) 1.18 (14.4) -0.16 (7.8)

* P > ChiSq for source in LR, type 3 if change greater than 0.10

Finally, older workers tended to have increases in pain intensity and disability. Intriguingly, men reported greater increases in work disability (and non-significantly lesser decreases in pain), unlike the common finding reported in the literature of women having more disability associated with WMSDs.

G.1.16c. potential confounders/effect modifiers and health status changes

potential confounders/effect modifiers	Health Status Changes (mean, SD)		
	Pain intensity	Work-DASH	*Quick*DASH
Age	**r= 0.151** (p=0.002)	**r= 0.172** (p=0.0005)	**r= 0.170** (p=0.001)
Gender (x, SD) W M	-4.31 (25.82) -0.86 (23.99)	**0.21 (18.70)**+ **3.65 (13.19)**	0.29 (15.8) 1.67 (10.92)
Tenure at Star	**r=0.089** (p=0.069)	r=0.061	r=0.038
Change in corrective eye-wear (x, SD) -1 stopped 0 no change +1 new	 -11.01 (23.68) -2.61 (24.87) -1.60 (26.10)	 -2.56 (16.29) 1.73 (16.84) 2.41 (16.25)	 1.87 (13.22) 0.74 (14.40) 1.29 (13.57)

*bold indicates significant at least at p<0.10
+note that unequal variances

Multivariate Analyses

In the multivariate models for Q4 health status prediction by domain, the number of significant change in potential risk factor variables reduced considerably for any particular health status outcome, even with generous p-value inclusion criteria of p up to 0.2 (table G.1.17).

Table G.1.17 Multivariate prediction of Q4 health status - Maximum likelihood analysis of variance tables (degrees of freedom Chi-Square, p value, listing those with p values <0.2)

G.1.17a. using more psychosocial predictors

Initial Set of Potential Predictors (all trichotomous change variables vs +1, continuous indicated.)	Q4 Pain Intensity (n= 357)	Q4 *Quick*DASH - function/symptoms (n=297)	Q4 WorkDASH - (n=346)
P1 health outcome (/unit)	2, 70.4, <0.0001	2, 53.7, <0.001	1, 33.8, <0.0001
Age (/yr)	2, 8.0, 0.02	2, 9.6, 0.008	1, 13.1, 0.0003
Gender M vs W	-	-	-
Seniority (/yr)	-	-	-
. JCQ - Decision Latitude (/unit)	-	2, 5.1, 0.08	1, 10.8, 0.001
. JCQ -" Psychological Workload" (/unit)	-	-	-
. JCQ - Work Social Support (/unit)	-	2, 3.3, 0.19	-
. Job Security -1 better 0 neutral	-	-	2, 6.6, 0.04

Worker Empowerment - Employees Ideas Listened To -1 better, 0 neutral	4, 7.8, 0.1	4, 12.0, 0.02	-
Frequency workers take part in decisions -1 better, 0 neutral	-	-	-
Management supportive re: RSI -1 better, 0 neutral	-	-	2, 8.5, 0.015
Supervisor aware and concerned re: RSI -1 better, 0 neutral	4, 7.0, 0.14	4, 6.9, 0.14	-

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G.1.17 b. using more biomechanical predictors

Initial Set of Potential Predictors (all trichotomous change variables vs +1, continuous indicated.)	Q4 Pain Intensity (n= 357)	Q4 *Quick*DASH - function/symptoms (n=297)	Q4 WorkDASH - (n=346)
P1 health outcome (/unit)	2, 69.9, <0.0001	2, 28.5, p<0.0001	1, 29.8, p<0.0001
Age (/yr)	2, 10.6, 0.005	2, 14.6, p=0.0007	1, 18.3, p<0.0001
Gender M vs W	2, 3.9, 0.14	-	-
Seniority (/yr)	2, 3.4, 0.18	-	-
Corrective eyeware -1 yes to no, 0 no change	4, 10.1, 0.04	-	-

Keyboard position -1 better 0 neutral time (hr/day)	-	-	-
Mouse time (hr/day)	-	-	1, 2.2, 0.14
Telephone type -1 better 0 neutral time (hr/day)	-	-	2, 9.9, 0.007
Sitting continuously -1 better 0 neutral	4, 6.8, 0.14	-	2, 3.3, 0.19
Physical Effort -1 better 0 neutral	-	-	-

We could then examine the program participation, work change and confounder prediction of this more limited set of change in WMSD risk factors. We combined some of the equipment and computer program changes into an "Other" category. As can be seen elements of the RSI Program implementation e.g., workstation assessment, and of other work changes e.g. job task changes, were important predictors of these transition variables, changes in risk factors between P1 and Q4 (table G.1.18 a-b).

Table G.1.18. Maximum likelihood analysis of variance table for predictors of WMSD risk factors (degrees of freedom Chi-Square, p value, listing those with p values <0.2. For ordered logit risk factors: 1=better, 2=neutral, 3=persist/worse)

G.1.18 a. Of more psychosocial risk factors

Potential "Predictors"	JCQ – Decision Latitude	JCQ – Work Social Support	Job Security	Employees listened to by management	Management supportive re: RSI	Supervisor aware & concerned re: RSI
Age (/yr)	1, 1.6, 0.01	-	2, 25.6, <0.001	-	-	-
Gender M vs W	1, 4.8, 0.03	1, 1.9, 0.17	-	2, 4.7, 0.09	2, 6.2, 0.04	-
Seniority (/yr)	1, 3.2, 0.08	1, 5.6, 0.02	-	-	-	-

Participation in RSI training (yes vs no)	1, 7.1, 0.008	-	-	2, 4.2, 0.12	-	-
Workstation assessment (yes vs no)	1, 3.5, 0.06	-	-	-	-	2, 3.5, 0.18
Multiple new equipment (yes vs no)	1, 2.8, 0.09	1, 3.65, 0.06	-	-	-	-
Other equipment or program change (yes vs no)	-	-	-	-	2, 4.4, 0.11	-
Increased computer use (yes vs no)	-	-	-	2, 4.6, 0.10	-	-
New job/team/workgroup /supervisor (yes vs no)	-	-	-	-	-	-
Different tasks, increased job responsibility, broader job scope (yes vs no)	1, 4.7, 0.03	-	-	-	-	-

G.1.18. b. Of more biomechanical risk factors

Potential "Predictors"	Corrective eyeware	Telephone Type	Mouse time	Sitting continuously
Age (/yr)	2, 17.5, <0.0002	2, 6.6, 0.04	-	2, 8.4, 0.01
Gender M vs W	-	2, 28.4, <0.0001	-	2, 4.9, 0.08
Seniority (/yr)	-	-	1, 3.5, 0.06	-

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Participation in RSI training (yes vs no)	-	-	-	-
Workstation assessment (yes vs no)	-	-	1, 3.5, 0.06	-
Multiple new equipment (yes vs no)	-	2, 7.6, 0.02	1, 2.9, 0.09	-
Other equipment or program change (yes vs no)	-	-	1, 3.6, 0.06	-
Increased computer use (yes vs no)	-	2, 4.9, 0.09	-	-
New job/team/workgroup/ supervisor (yes vs no)	-	-	-	-
Different tasks, increased job responsibility, broader job scope (yes vs no)	-	2, 9.2, 0.01	-	-

We next examined P1 health status effects on significant participation and work change variables. In table G.1.19, one can note that those with more symptoms and disability were more likely to report participating in the RSI training programme. They tended to be more likely to have a workstation ergonomic assessment (though not significant by even the most lenient criteria). However, they were no more likely to experience changes in equipment or job task changes, perhaps in keeping with the fact that major renovations, moves and other work changes were business decisions not related to WMSD.

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Table G.1.19. Potential health-based selection into RSI Program participation among cohort members

Program Component		Health status measure (mean, SD)		
		Pain intensity	*Quick*DASH	WorkDASH
RSI Training	Yes	30.8 (26.4)	11.0 (16.2)	6.7 (15.1)
	No	25.1 (26.7)	6.7 (11.4)	5.1 (15.5)
	Difference	5.7 (26.5)	4.3 (15.3)	1.6 (15.2)
	Significance	p=0.07	p=0.009	p=0.38
Ergonomic Assessment	Yes	31.0 (26.7)	10.7 (15.9)	6.6 (15.4)
	No	27.9 (26.3)	8.9 (13.9)	5.8 (14.2)
	Difference	3.1 (26.5)	1.8 (15.1)	0.8 (14.9)
	Significance	p=0.24	p=0.25	p=0.57
Multiple new equipment	Yes	30.6 (27.3)	10.6 (15.7)	5.9 (14.0)
	No	28.4 (25.2)	8.8 (13.9)	6.7 (16.1)
	Difference	2.2 (26.5)	1.8 (15.0)	0.8 (14.9)
	Significance	p=0.40	p=0.27	p=0.61
Other equipment or program change	Yes	29.6 (26.5)	9.7 (14.9)	5.9 (14.2)
	No	30.6 (27.2)	11.3 (16.2)	8.5 (18.5)
	Difference	1.0 (26.5)	-1.6 (15.1)	-2.6 (14.8)
	Significance	p=0.80	p=0.51	p=0.32

Job task changes			
Yes	30.3 (26.5)	10.0 (14.9)	5.5 (13.9)
No	28.7 (26.6)	9.7 (15.3)	7.4 (16.4)
Difference	1.7 (26.5)	0.3 (15.1)	1.9 (14.8)
Significance	p=0.53	p=0.87	p=0.21

We were then ready to go back to the conceptual framework of change analysis and focus down on fewer variables for path analyses. In Tables G.1.20 a-c below, we set out these relationships from left to right as in Figure G.1 above. In path analysis syntax, variables to the right in the diagram map on variables that are to the left, or more upstream in the presumed causal model, although the middle sets of variables participation and work change variables and change in risk factor variables are truly about associations, since they are co-temporaneous. Ratios of parameters to their standard errors are the same as z-scores. In tables G.1.20 a-c, we first set out the starting model, followed by the reduced model. The latter was based on successive removal of those variables with z score values >1.6 (approximate p value of 0.1) and monitoring of model fit based on the CFI and TLI indices (high is good, above 0.8 aimed at) and RMSEA values (low is good, below 0.05 aimed at). Fits for all final models were generally good.

Table G.1.20 Path Analyses, initial and final models for prediction of Q4 health status measures

a. Pain Intensity

Participation and work changes onto P1 measure		Δ Risk Factors onto Participation & Work Changes and confounders		Q4 measure onto Δ Risk Factors, Confounders, participation, work changes, P1 measure	
Variable mapping	Parameter (SE) Ratio	Variable mapping	Parameter (SE) Ratio	Variables mapped onto	Parameter (SE) Ratio

INITIAL MODEL RSI training	 0.004 (0.003) 1.5	Δ <u>employees ideas listened to</u> onto: gender (M vs.W) RSI training increased computer use Δ <u>supervisor awareness &</u> <u>concern</u> onto: workstn. asst. Δ <u>corrective eyeware</u> onto: age Δ <u>sitting continuously</u> onto: age gender (M vs.W)	 0.013 (0.134) 0.1 -0.072 (0.093) -0.08 0.203 (0.145) 1.4 0.112 (0.148) 0.8 0.024 (0.010) 2.4 0.001 (0.010) 0.1 0.116 (0.133) 0.9	age (per year) gender (men vs women) seniority (per year) Δ listened to by management Δ supervisor awareness & concern Δ corrective eyeware Δ sitting continuously P1 pain intensity	0.026 (0.010) 2.6 -0.139 (0.131) -1.1 -0.010 (0.010) -1.0 0.059 (0.079) 0.7 0.102 (0.078) 1.3 0.001 (0.077) 0.0 0.115 (0.069) 1.7 0.022 (0.003) 8.4

FINAL MODEL* RSI training	 0.006 (0.003) 2.1	[none, i.e. no mediation]		age (per year) Δ supervisor awareness & concern improved vs worse no change vs worse RSI training P1 pain intensity	0.018 (0.007) 2.4 -0.356 (0.292) -1.2 -0.512 (0.196) -2.6 0.146 (0.078) 1.9 0.022 (0.003) 8.9

* CFI/TLI of 1.0/1.1, RMSEA 0.000 i.e. excellent fit

b. *Quick*DASH

Participation and work changes onto P1 measure		Δ Risk Factors onto Participation & Work Changes		Q4 measure onto Δ Risk Factors, Confounders, participation, work changes, P1 measure	
Variable mapping	Parameter (SE) Ratio	Variable mapping	Parameter (SE) Ratio	Variables mapped onto	Parameter (SE) Ratio
INITIAL MODEL		Δ decision latitude onto: gender	-0.473 (0.376) -1.3	age (/year)	0.027 (0.012) 2.3
RSI training	0.011 (0.007) 1.7	Age (/year)	-0.079 (0.025) -3.2	Δ decision latitude	-0.037 (0.025) -1.5
		Seniority (/year)	-0.032 (0.029) -1.1	Δ work social support	-0.004 (0.030) -0.1
		RSI training	0.376 (0.224) 1.7	Δ employees ideas listened to	0.088 (0.075) 1.2
		Workstation assessment	0.635 (0.346) 1.8	Δ supervisor awareness & concern	0.134 (0.091) 1.5
		Multiple equipment change	-0.499 (0.373) -1.4	P1 *Quick*DASH	0.053 (0.007) 7.9
		Job task changes	0.534 (0.384) 1.4		
		Δ work social support onto: gender	-0.178 (0.275) -0.6		
		Seniority	0.073 (0.024) 3.1		
		Multiple equipment change	-0.350 (0.280) -1.3		
		Δ employees ideas listened to onto: gend.	-0.107 (0.153) -0.7		
		RSI training	-0.095 (0.095) -1.0		
		increased computer use	0.232 (0.178) 1.3		
		Δ supervisor awareness & concern onto: workstation asst.	0.033 (0.164) 0.2		

FINAL MODEL*		Δ decision latitude onto: Age (/year)	-0.093 (0.019) -4.9	age (/year)	0.023 ((0.009) 2.6
		RSI training	0.524 (0.227) 2.3	Δ decision latitude	-0.039 (0.024) -1.7
RSI training	0.014 (0.006) 2.4	Workstation assessment	0.623 (0.336) 1.9	P1 *Quick*DASH	0.055 (0.006) 8.8
		Job task changes	0.694 (0.342) 2.0		

* CFI/TLI 0.903/0.806, RMSEA 0.074

c. WorkDASH

Participation and work changes onto P1 measure		Δ Risk Factors onto Participation & Work Changes		Q4 measure onto Δ Risk Factors, Confounders, participation, work changes, P1 measure	
Variable mapping	Parameter (SE) Ratio	Variable mapping	Parameter (SE) Ratio	Variables mapped onto	Parameter (SE) Ratio
INITIAL MODEL		Δ decision latitude onto: gender	-0.783 (0.370) -2.1	age (/year)	0.041 (0.015) 2.7
		Age (/year)	-0.086 (0.025) -3.4	Δ decision latitude	-0.068 (0.030) -2.3
RSI training	0.005 (0.005) 0.9	Seniority (/year)	-0.033 (0.029) -1.2	Δ job security	-0.019 (0.094) -0.2
		RSI training	0.601 (0.237) 2.5	Δ management support for RSI	0.311 (0.118) 2.6
		Workstation assessment	0.502 (0.340) 1.5	Δ mouse time (/hour)	0.100 (0.037) 2.7
		Multiple equipment change	-0.658 (0.364) -1.8	Δ telephone type	-0.317 (0.110) -2.9
		Job task changes	0.673 (0.373) 1.8	Δ sitting continuously	0.137 (0.092) 1.5
			-0.003 (0.012)	P1 WorkDASH	0.036 (0.006)

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		Δ job security onto: Age (/year)	-0.304 (0.241) 2.0		5.9
		Δ management suppt. for RSI onto: gdr.	-0.184 (0.241) -0.8		
		Other change in equipment/programs	-0.039 (0.020) -1.9		
		Δ mouse time (/hour) onto: seniority (/yr)	0.388 (0.252) 1.5		
		Workstation assessment	0.226 (0.250) 0.9		
		Multiple equipment change	0.403 (0.371) 1.1		
		Other change in equipment/programs	0.608 (0.160) 3.8		
		Δ telephone type onto: gender	0.016 (0.014) 1.2		
		age (/year)	-0.478 (0.168) -2.8		
		Multiple equipment change	-0.086 (0.172) -0.5		
		Increased computer use	0.321 (0.167) 1.9		
		Job task changes	0.073 (0.149) 0.5		
		Δ sitting continuously onto: gender	0.010 (0.011) 0.9		

FINAL MODEL* (2 columns dropped as no mapping of any variables onto P1)

Δ <u>decision latitude</u> onto:	gender	-0.769 (0.360), -2.1	age (/year)	0.033 (0.015), 2.2
	Age (/year)	-0.082 (0.025), -3.3		
	RSI training	1.080 (0.425), 2.5	Δ decision latitude	-0.076 (0.029), -2.6
	Multiple equipment change	-0.593 (0.350), -1.7		
	Job task changes	0.565 (0.353), 1.6	Δ management support for RSI	0.269 (0.109), 2.5
<u>Δ management support for RSI</u> onto:	gender	0.517 (0.237), 2.2	Δ mouse time (/hour)	0.089 (0.037), 2.5
Δ <u>mouse time</u> (/hour) onto:	seniority (/year)	-0.040 (0.020), -2.0	Δ telephone type	-0.295 (0.102), -2.9
Δ <u>telephone type</u> onto:	gender	0.596 (0.157), 3.8	P1 WorkDASH	0.035 (0.006), 6.1
	Multiple equipment change	-0.478 (0.166), -2.9		
	Job task changes	0.325 (0.159), 2.0		

* CFI/TLI 0.936/0.908, RMSEA 0.029

The strongest effects in all three models were for P1 health status on Q4 health status, consistent with persistence of pain and disability over time. Age was also positively associated with (worse) Q4 health status in all final models. RSI training participation remained associated with P1 health status for pain intensity and general disability, but not work disability. The path model for pain intensity did not show mediation by changes in risk factors, but thar for the disability health status measures did, with participation and work changes affecting changes in risk factors. For the pain intensity model, RSI training was associated with greater pain at P1 and at Q4, indicating selection effects into the intervention. Maintenance or improvement in supervisor awareness and concern was associated with decreases in Q4 pain intensity. For the general neck and upper extremity disability (*Quick*DASH) model, job task changes, RSI training and having a workstation assessment were all positively associated with increases in decision latitude, which in turn were associated with decreased disability at Q4.

For work disability, a wide variety of interventions, changes in physical and psychosocial risk factors and confounders were linked to Q4 health status, in a relatively complex path model. Although the same relationships were observed as in the *Quick*DASH model, additional influences on both change in risk factors and Q4 Work DASH are apparent. Such complexity makes interpretation of any particular coefficient difficult.

Of interest, is that men were more likely than women to report decreases in decision latitude but increases in management support for RSI and persistence of poorer telephone types. Intriguingly, multiple equipment change was associated with both reductions in decision latitude, perhaps indicating the large number of lower level Advertising employees involved in the move, as well as improvement in telephone types (negative coefficient on risk for increased pain). The fact that greater decision latitude is associated with decreased pain, makes sense if employees have greater ability to adjust their work demands to their current condition. Similarly, greater time mousing being associated with greater levels of Q4 work disability makes sense. However, improved management support for RSI may seen counter-intuitive, unless those that develop pain are more likely to see that management is supportive, because they need that support. Similarly, if those with pain over the period ended up receiving more flexible telephone types such as head sets, then those that remained with hand or shoulder held phones may have been those without pain. Review of the ergonomic assessment reports (section E.1) did indicate that headsets and less stressful phone types were often recommended in reaction to having pain, rather than more pro-actively for those with a lot of phone work, perhaps because of their cost. In this sense, it remains hard to interpret such change over time in causal terms, with post-hoc explanations taking root to understand the relationships. At least, in the way we carried out modeling, different kinds of variables along the path are not conflated, nor can confounding by the usual demographic variables be a big problem. Such difficulty teasing out of both intervention effects and directions in causality are unfortunately related to the complexity of relationships and practices in the workplace as was noted by other authors in the literature review section (A) above. Exploration of further comparisons with the literature is in process.

G.2 ADMINISTRATIVE DATA TREND ANALYSIS

Rationale

Sickness absence data has long played a role in documentation of change in Scandinavian studies of WMSD (e.g. Häkkänen et al., 1997). Self-report absence data has been linked to hazardous working conditions (e.g. Leigh, 1991) although problems exist with self-reports that can be obviated by using employer data sources (Johns, 1994). Workers' compensation data has played an ongoing role in evaluation of interventions in US jurisidictions (e.g. Heller, 1997). Administrative data sources can potentially provide more valid out-patient health care utilization data than patient recall for periods longer than a few weeks (Roberts et al., 1996). Linkage between a variety of secondary data sources is a mainstay of large occupational cohort chronic disease incidence and mortality studies, yet it has played a far smaller role with workplace based primary data sets. Nevertheless, Sorock et al recently pointed out the value in using linked data bases for more up-to-date workplace surveillance (Sorock et al., 1997). The workplace parties are interested in using existing data to better determine problem areas for attention by the RSI Committee and to evaluate the impact of the RSI Program.

In the province of Ontario, workers' compensation is paid for by the Workplace Safety Insurance Board (WSIB). Workers' compensation claims may either be for health care only or for time lost from work. Many workplaces in Ontario offer enhanced medical coverage through an insurance company for services not covered by OHIP. At the Toronto Star, employees had supplemental health insurance and disability coverage provided by Liberty and Sunlife Insurance Companies. In addition, the Toronto Star directly provided employees up to approximately US$1000 per year for treatment for RSI. Toronto Star employees could also visit occupational health nurses at the on-site health care centers.

G.2.1 Data Collection and Measures

In the fall of 1998, all staff were asked for informed consent to obtain data from several secondary sources (see table G.2.1 below) and link it with data from the cross-sectional surveys. However, only 13% consented and this poor response had two major consequences. First, we have obtained anonymized data (i.e., no meaningful identifying information was provided) at the individual level covering the period 1992 to the present from a variety of sources as outlined in the table below. These data have been obtained in a manner in which it is possible to trace an individual's data through any one data source, but it is not possible to link, as per our original plan, an individual's data across data sources. Changes in provincial privacy legislation also made it impossible for us to obtain the Ministry of health provincial health insurance plan data..

Table G.2.1 Administrative data sources of potential use for trend analysis

Source	Description	Level of Aggregation	Status
Ontario Workplace Safety & Insurance Board (OWSIB)	- workers compensation claims - LT and NLT - information on injury codes, costs, duration, health care benefits (including types of practitioner, health services)	- individual claim level data, anonymized	obtained data
Medical Insurance Carrier (two separate sources as the insurance company changed over the study period)	- individual level billing data as submitted to the insurer with information on the type of service, the service provider and detailed drug information	- individual bill level data, anonymized	obtained data
Workplace HR system	- tracking incident reports at the workplace for first aid, health care and claims (some overlap with OWSIB data)	- individual level data, anonymized	obtained data
Workplace tracking system for administering special physiotherapy fund	- monthly costs and dates of visits for physiotherapy paid for by the employer	- individual level data, anonymized	obtained data (not completed)
Workplace occupational health unit	- visits to the occupational health unit for RSI	- individual visit level data, anonymized	obtained data (not completed)
Workplace - on-site physiotherapy clinic	- visits to the on-site physiotherapy unit (starting in 1999)	- individual visit level data, anonymized	obtained data (not completed)
Workplace - sickness absence	- not collected in a uniform manner across the company (what collected and level of detail depends on job and department)		Not obtained because not interpretable
Workplace - Number of Employees	- number of employees by department over time	- aggregate level	obtained, but not available prior to 1990
Ministry of Health provincial health insurance plan	- physician and chiropractic visits	- individual level visits, anonymized	Not available due to changes in privacy legislation

With each of the data sources obtained, we have created several series of quarterly measures reflecting health care utilization (e.g., physiotherapy, medications), injury reports, and claims over time.

From health care services files, quarterly measures from January 1, 1992 through December 31, 2002 (i.e., January through March 1992, etc.) were created at the individual worker level representing total health care costs, number of practitioners seen, type of practitioners seen (e.g., family doctor, physiotherapist, occupational health nurse etc.), number of visits and type of care received (e.g., physiotherapy, massage therapy etc.) and type of medications taken. All data were limited to employees aged 65 and under to avoid including retirees.

Three outcome measures representing accident reports and health care costs were created each as time series, especially for physiotherapy utilization and MSK related drug utilization; # billings(or # visits), # health care users, total number of accident reports for WMSD, and the costs for WMSD. 44 data points for each quarterly measurement outcomes, starting at January 1, 1992 and ending at December 31, 2002, were used as numerators and # employees at the firm in year was constructed for each time period to serve as a denominator. Due to the availability of # employees by year, some measures were constructed on a yearly basis (e.g., # populations in each data sources, health care costs) and the same # employees within a year was applied as a denominator for quarterly data.

G.2.2 Analysis

The time series data were plotted visually to examine whether there are changes in health care utilization and accident reports. The goals of the RSI committee include "preventing the occurrence of RSI" and "reducing the severity of RSI". The challenge was to describe 11 year trends in health care utilization for WMSD to see whether a workplace ergonomic intervention program (1998-2001) would lead to decreases in the related health care utilization, incident reports, and the associated costs. If the workplace intervention were successful in reducing the impact of WMSD in the workplace, we anticipated an eventual reductions in, health care, and workers' compensation costs. We subdivided the overall time into periods of pre-collaborative research (1992-1994), etiologic research (1995-1997) and intervention research (1998-2002).

G.2.3 Results and Discussion

Tabular presentation of the populations and user/claimants can be seen in Table G.2.1. It should be noted that, although the overall number of workers' compensation claimants and number related to WMSD did not decline, the number of lost time WMSD claims decreased considerably from a high of 11 claims and 821 lost days in 1995 to a low of 0 and 0 days in 2001(see Appendix VI) i.e. lost time claims were brought under control both with implementation of the RSI program and with greater attention to work accommodations, including provision of special equipment such as voice activated software, adaption of job tasks to abilities, and support to those with more chronic WMSD.

Table G.2.2. # Study Population by study time period and rates per 1000 employees (year 1992 to

2002)

Year	Workplace Number of Employees	Ontario WSIB N claimants (rate) N of WMSD claimants (rate)	Medical Insurance Carrier N of any kinds user (rate) N of MSK related drug and physio users (rate)[2]	Special Physio-therapy fund N (rate)	Workplace-On-Site Physio-therapy clinic N (rate)
1992	2160	180 (83) 148 (69)	1935 (895) 922 (427)	na	na
1993	2021	179 (89) 134 (66)	1855 (918) 884 (437)	na	na
1994	1769	151 (85) 123 (70)	1703 (963) 841 (475)	na	na
1995	1800	203 (113) 173 (96)	1701 (945) 810 (450)	22 (12)	na
1996	1792	165 (92) 129 (72)	3360 (1875) 1027 (573)	45 (25)	na
1997	1807	135 (75) 99 (55)	2026 (1121) 774 (428)	175 (97)	na
1998	1884	150 (80) 113 (60)	2534 (1345) 875 (464)	183 (97)	na
1999	1879	169 (90) 123 (65)	1559 (830) 713 (379)	377 (201)	70*** (37)
2000	1914	178 (93) 137 (72)	1744 (911) 743 (388)	93 (49)	228***(119)
2001	1901	219 (115) 177 (93)	1658 (872) 738 (388)	54** (28)	253***(133)
2002	1818	161 (89) 119 (65)	1584 (871) 704 (387)		242 (133)

1. 5 MSD related drug groups and physiotherapy (nonprescription billing)
* at year 1996, the newspaper company had changed the insurance company from Liberty to SunLife and the study was NOT allowed to identify person in two insurance companies. It might make person double counted
** It has to be completed at the end of 2001. The first 2 quarters only available
*** The #s may include people from Vaughan office as well as Yonge

Health care utilization results demonstrated substantial uptake of new services (Figure G.2.1). The graph illustrates # employees receiving physiotherapy per 1000 employees by different health care payers. The growth in utilization of workplace supported services (first occupational health unit services, then special fundon-site physio, and finally on-site physio) is consistent with greater accessibility of services to respond to previously unmet health care needs. It is also consistent with greater awareness of RSI/WMSD and improved support from management found in the repeat x-sectional surveys (see section G.1 above), the reduction in time between onset of symptoms and first physio appointment (section E.2. above) and the very positive feelings about on-site physio that interviewees shared with us in the qualitative component (see section G.3 below).

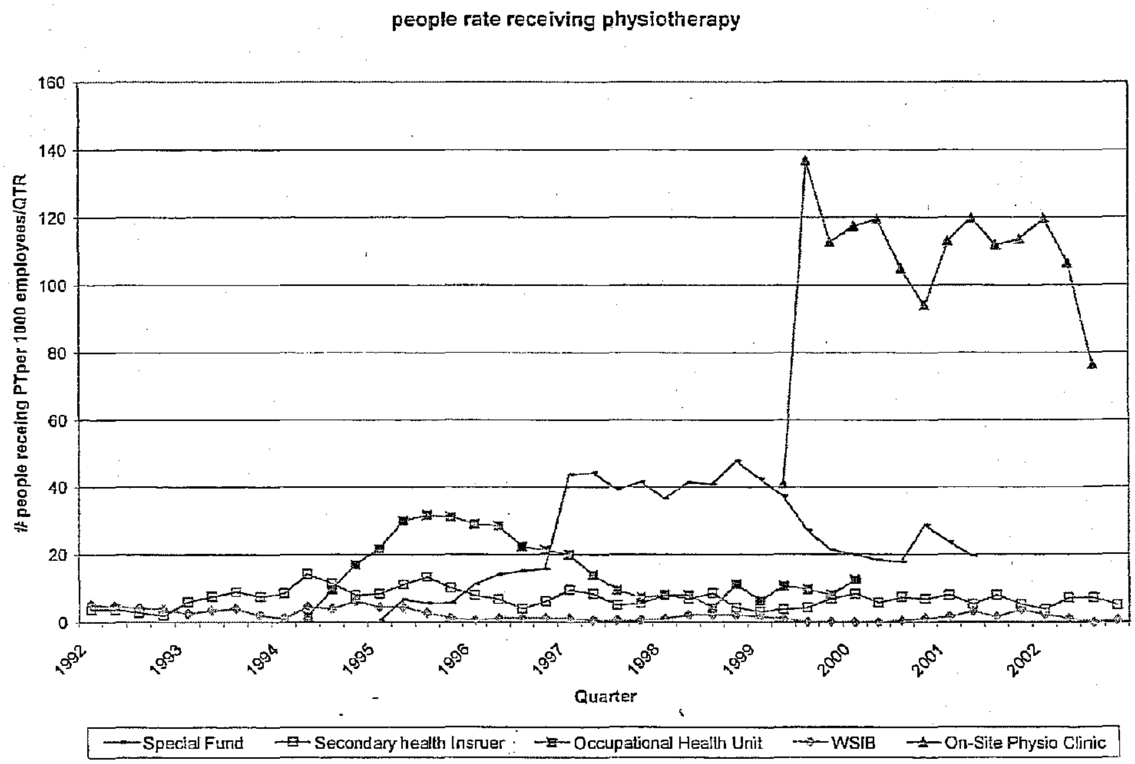

Figure G.2.1 Proportion of employees receiving physiotherapy services by source and by quarter (1992-2002)

Trends in utilization of typical musculoskeletal (MSK) related drugs were dramatic (Figure G.2.2). Although analgesics and muscle relaxants remained at relatively low levels of use, opiate agonists increased over recent years, perhaps in keeping with employees decreased willingness to tolerate symptoms, as no changes in the extent of reimbursement occurred. The impact of the introduction of the newer non-steroidal anti-inflammatory drugs (NSAIDs) such as the expensive Cox-2 inhibitors, had significant impacts on overall costs during the last several years. When we presented these data to senior management and union representatives, considerable controversy over the results ensued, as they wrestled with their lack of control of escalating costs associated with new pharmaceutical technology, pricing policies and physician prescribing practices.

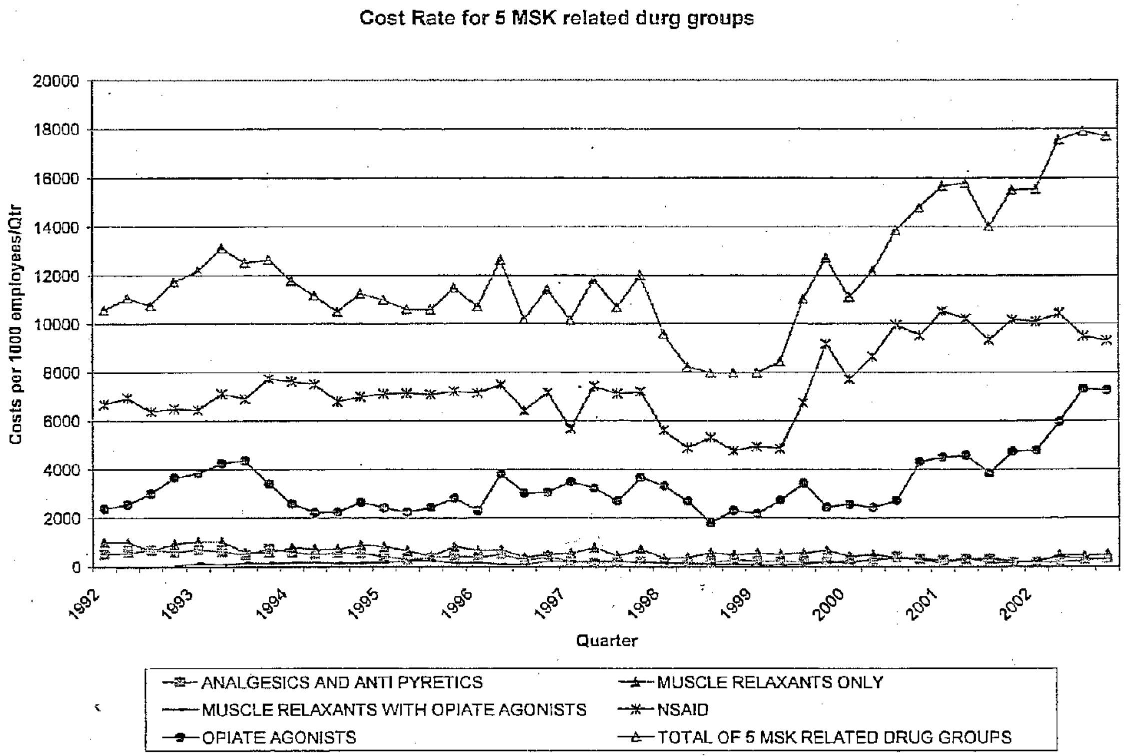

Figure G.2.2. Prescription drug costs per 1000 employees by drug group and quarter

Unfortunately, such secular trends make evaluation of benefits associated with workplace intervention programs based on aspects of health care utilization particularly difficult. However, bringing together the different sources of health care utilization data relevant to WMSD among this employee population was useful for the RSI Committee and other workplace parties, since they had not considered the full impact of WMSD on their employee population. They plan to monitor such combined trends more closely in future years. As a research team, we are carrying out comparisons with other literature on both secular trends in health care utilization and approaches to synthesis of such data for workplace parties (Lee et al., in preparation).

G.3 QUALITATIVE DOCUMENTATION AND ANALYSIS

Rationale

Developing a fuller picture of the implementation of the RSI Program, understanding the mechanisms by which the Program produces effects and identifying any unintended consequences of the Program are all research tasks for which multiple qualitative research techniques are best suited (Mullen & Inverson, 1986;Chen, 1994). Indeed, there are widespread calls for the combined use of qualitative and quantitative methods to better understand complex social settings generally (Bednarz, 1985), and workplace change initiatives in particular (Polanyi et al., 1998). Qualitative research methods have particular utility in intervention research in complex social organizations such as workplaces, where social relationships can be as important as physical components in determining the ultimate impact of an intervention. Understanding the nature of change, its meaning for employees, how the behaviours and beliefs of workers are influenced, and how these behaviours and beliefs in turn stimulate or hinder individual and organizational changes in workplaces is best done through qualitative methods (Needleman and Needleman, 1996).

G.3.1 Data Collection

In our experience, workplace parties may not always appreciate the importance of changes in workplace policies, structures or activities in changing risk factors for WMSD, unless the researchers are actively engaged with them. Participation in joint labor-management meetings of both the RSI Committee and the Team Restructuring Committee were an important input not only for understanding the nature of RSI Program implementation but also identification of organizational and procedural changes relevant to WMSD. Field notes were kept by researchers participating in these meetings, for subsequent review, past the end of the grant (last attended October, 2003).

Key documents were reviewed on an ongoing basis including Committee meeting minutes, the in-house publication "STARBEAT", relevant sections of Joint Health and Safety Committee information and minutes, purchasing reports, occupational health-service policies and treatment reimbursement agreements.

Interview questions were phrased in an open ended way (e.g., "tell us about your experiences since...") to allow us to build a deeper understanding of the ways that employees account for their experience of organizational change, particularly in relation to RSIs. Topics included the nature of the changes in their work, any impact on risk factors for, symptoms of or disability associated with WMSD and further suggestions for changes in team work, organization or relationships that might deal better with risk factors, symptoms or disability associated with WMSD. We also included discussion of any personal changes, both for themselves and others, in knowledge, attitudes and behavior that they may have attributed to the education and training program and probed any incentives for or barriers to implementing the suggestions for reducing WMSD risk factors and dealing with symptoms advocated in the program.

A first wave of semi-structured interviews (N=13) was conducted with RSI Committee members and other workplace participants who played key roles in the development and implementation of the RSI Program. A second wave (N= 21) extend the interviews to managers and workers not centrally involved in the program. Purposive sampling ensured a diversity of interviewees: men and women, union and management, those with and without RSI symptoms, workers from different departments and employees at different hierarchical levels within the organization. With signed consent by participants, interviews lasting from 45 to 75 minutes were tape-recorded, transcribed and audited.

G.3.2 Analysis and Interpretation

The various sources of qualitative information were analysed for common and divergent themes by multiple coders to improve validity (Miles and Huberman, 1994). Systematic documentation of themes and application of codes was facilitated through the use of NVivo software (1999). The coding framework was developed iteratively, in keeping with grounded theory techniques (Strauss and Corbin, 1990). Different researchers open-coded each interview. We discussed our coding approaches and collectively amalgamated, refined and added themes, until all authors were satisfied with the coding framework. Interviews were then re-coded accordingly. Finally, the authors summarized common and divergent themes across participants. Any immediate suggestions arising out of preliminary analysis were fed back to the RSI Committee for consideration. Findings were compared with quantitative findings with the intent of cross-validation (Mullen and Iverson, 1986).

In addition, we are undertaking a secondary analysis across waves of interviews (Ferrier et al., 2003). Secondary analysis of qualitative data remains a relatively unexplored field (Heaton, 2002). With qualitative data collected over a six year period at The Toronto Star, the opportunity to undertake a secondary analysis of the archived data longitudinally presented the possibility of exploring this area more fully. In-depth semi-structured interviews conducted over a six year period at The Toronto Star were included for this analysis. This includes data from interviews conducted with employees in 1995 to inform the design for Phase 1 of the research as well as interviews from Phase 2 about the experiences of coping with RSI along with another set of interviews regarding work, RSI, and gender collected in 1997, and a final set of interviews collected in 2000/2001 (Phase 3) that explored employees' perceptions about RSI as well as organizational changes made to their workplace. All interviews were tape-recorded and transcribed verbatim. Additionally, all of the authors had spent time involved with the primary studies at the newspaper (two of us for more than six years) which gave us a particular sensitivity to the context in which the archived data were collected (Hinds, 1997). The objective of this analysis will be to examine the different ways workers construct or make sense of WMSDs and to discuss, what (if any) are the implications of these constructions/perceptions.

G.3.2 Results and discussion

Contextualization of RSI Program implementation

Out of this analysis, we produced both an overall time-line of key events relevant to RSI/WMSD at the newspaper over the last decade (see Appendix VI) and an IWH working paper on factors influencing implementation (Polanyi et al, 2003). We argue that workplace ergonomic programs to reduce the burden of work-related musculoskeletal disorders (WMSD) of the upper limb must address "upstream" physical and psychosocial aspects of work environments yet a variety of contextual factors may impede or facilitate such a task. The paper explores the impact of contextual factors on implementation of a workplace ergonomic program at a large newspaper. The paper illustrates how key contextual characteristics of the program (management commitment, union pressure, experience and skill of program leaders, and researcher involvement), organization (drive for productivity, management control, organizational culture) and broader social context (economic climate, nature of newspaper work, technology and nature of WMSD) affected the program's success (see Figure G.3.1). It argues for increased attention to identification and response to the contextual factors affecting program implementation in order to more successfully address upstream determinants of WMSD.

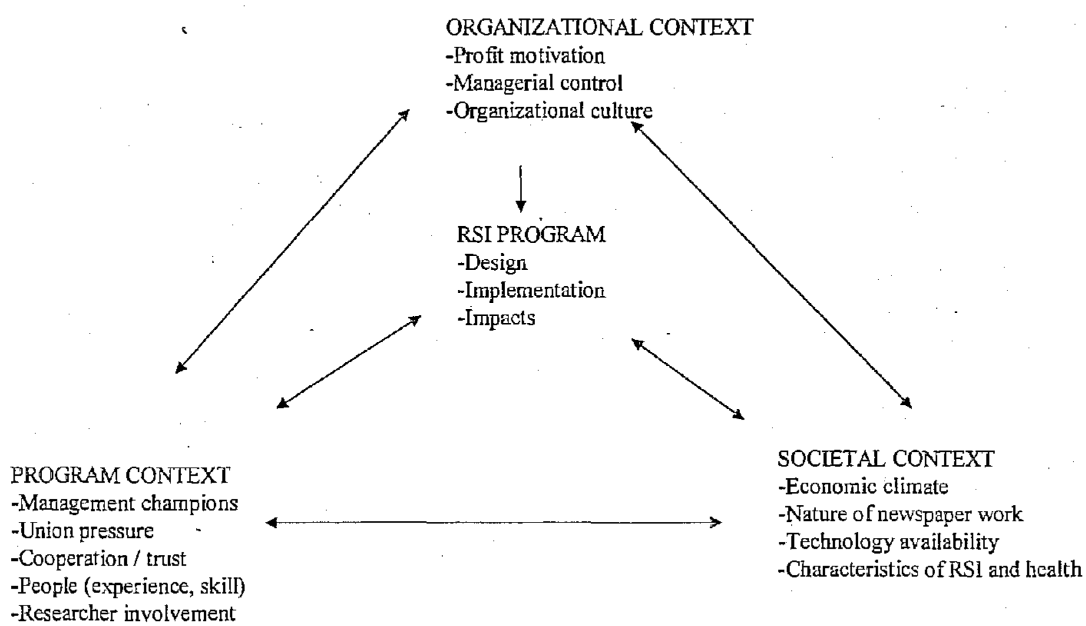

Figure G.3.1. Contextual Influences on Implementation of the RSI Program/Ergonomic Policy

Social Construction of RSI/WMSD over time

We know that how workers perceive of or account for work-related musculoskeletal disorders (WMSD) or repetitive strain injury (RSI) as these newspaper workers named it is infrequently treated or non-existent in the organizational and intervention literatures and anticipate that this analysis will contribute to these literatures. Secondary analysis of these data sets is underway using a grounded theory approach where a comparative analysis occurs first. Thus, open coding (development of initial categories of information related to perceptions of RSI) (Ferrier and Lavis, 2003) has been undertaken by two of the authors who read the same set of six transcripts and then meet to compare the codes each has assigned to categories or concepts identified in the text. Differences in the coding are resolved by examining segments of the transcripts until agreement is reached and a refined list compiled. This process is continuing but has a complication which Hinds (1997) warned can occur in secondary analysis of qualitative data. Although all the data sets are grounded theory ones, gaps or missing data have been observed. The reason for this, however, is yet to be determined. Preliminary axial coding where categories are related in order to build an explanatory scheme (Strauss and Corbin,1998) has also begun.

Initial impressions suggest that workplace reaction to RSI evolved over time from uncertainty about its existence to an acceptance that the condition was "real". It appears to first have become legitimized at The Star by two "pioneers". One was a journalist who wrote a series of articles for the paper about his experience in dealing with RSI which may have been one springboard that enabled other employees to begin reporting their symptoms to the workplace. The other was a reporter who appeared to find internal validation by winning a national writing award in spite of having RSI but who also publicized the condition in the newsroom by discussing it with Star colleagues. And later on, the company increased the legitimacy of RSI through their involvement with the research and the RSI Program.

Finally, through attendance at RSI Committee meetings, we have been impressed at the extent to which the workplace parties have taken up the research findings. For example, they used the repeat x-sectional survey results to guide areas for concentration during special sessions with supervisors. They have incorporated information from earlier versions of the Ergonomic Assessment database into revisions to the assessment form. Finally, they have undertaken new initiatives that draw on their employees' particular skills in media work, to create highly creative tools such as a set of posters forming part of a renewed campaign to maintain awareness of RSI/WMSD.

CONCLUSIONS

We now synthesize our findings across the different components by returning to the specific aims of the research.

An important aim (#1) was to document the interventions undertaken by workplace parties. Through participation in RSI Committee meetings we observed the development of an innovative Ergonomic Policy with combined primary and secondary prevention components (section G.3). Over five years, 1000 Ergonomic Reports/Workstation Assessments were completed by over 40 trained assessors, proactively reaching 881 employees as part of an active hazard and symptom surveillance program (aim #5). The latter included 138 employees that were not reached in any of our survey activity, although 56% (459) of Q4 2001 survey respondents did report workstation assessments. The surveillance system met a number of the important criteria for such systems, including utility through a wide range of improvements either directly made, planned or improved as a result of these assessments (section E.1).

Special RSI/WMSD training sessions were held in all departments, with 58% of Q4 2001 survey respondents remembering these sessions and another 11% indicating that they received training on RSI/WMSD as part of their orientation. Further, 72% of Q4 respondents with pain reported being engaged in a wide variety of active efforts to respond to pain, including: doing exercises (65%), making posture changes (59%), seeing a health practitioner (57%), reporting their pain to the workplace (40%), educating themselves (38%), and using relaxation techniques (31%).

From administrative data, we noted substantial increases in health care utilization, particularly physiotherapy services promoted by the RSI Program. Over time, these physiotherapy services were reaching employees with WMSD earlier than had been the norm prior to their introduction. MSK-related drug utilization and particularly costs of NSAIDs also increased through the intervention period, though we had hoped to demonstrate reductions in costs over time (Aim #6). This was achieved in workers' compensation claim related absence (to 0 new lost time claims in 2001) but nowhere else due to a combination of meeting previously unmet needs for physiotherapy and escalating costs associated with changing drug availability and prescribing patterns.

Interviews gave us a clear sense of considerable changes in awareness, knowledge and attitudes towards RSI/WMSD (Aim# 2) during the period of research (section G.3). 90% of Q4 2001 survey respondents felt that The Toronto Star RSI Program had completely to moderately "ensured that all employees are informed about RSI". Compared to our earlier P1 1996 survey, significantly greater endorsement of relevant responses as to potential causes of RSI/WMSD were observed e.g., workstation, tools, breaks, keyboarding, workload, exercise and posture, at the same time that "lack of training" was mentioned less frequently. These indicated important changes in knowledge on RSI/WMSD. Further, 85% of Q4 respondents completely to moderately agreed that the RSI Program "promoted continuous improvement in the technology and management practices to control exposure to workplace risk factors that can cause RSI" and 74% agreed or strongly agreed (vs. 64% in 1996) that Toronto Star management were supportive in dealing with RSI.

Nevertheless similar proportions indicated that their immediate supervisor was aware and concerned about RSI and the proportion of respondents who disagreed that "I can take breaks when I want to" was unchanged from 1997 to 2001 (28%). The interviews helped provide explanations where little change occurred. As one manager said, "…productivity is really important here. You have to be always available on your phone. And all their incentives …[are] based on how much you're producing." Similarly, changes were not as apparent in proactive technology choices and job design as RSI Committee members and we had hoped for due to the limited mandate of the RSI Committee and a range of sectoral, company and departmental level constraints (section G.3).

This theme recurred in our assessment of changes in physical and psychological risk factors for WMSD and WMSD symptoms among employees who underwent a move and reorganization process into teams (Aim #3). Among a small group of predominantly advertising employees undergoing direct measures, we noted reduced extreme mouse positions (horizontal and vertical), fewer monitors to the side with less head rotation, and fewer extreme head tilts, the last despite monitor heights being generally higher (section F.1). Among the psychosocial factors, fewer task variables changed than expected, though increases in keyboard time and post-reorganization mousing time were positively associated with changes in employee pain (section F.2, and corroboration in section G.1). Informal information collected while contacting workers during the intensive exposure and formal interviews with those in teams and not in teams (section G.3) suggested that, in practice, employees' jobs had changed little except for increased use of computers through introduction of new software.

The RSI Program was associated with some positive changes in self-reported exposures to physical and psychological risk factors for WMSD and a concomitant reduction in the self-reported period severity but not prevalence of WMSD-related symptoms (Aim # 4). Overall the proportion reporting equipment inside a preferred location increased between P1 in 1996 and Q4 in 2001 from 56% to 72% for the keyboard and 17% to 61% for the mouse (section G.1). Increased use of computer (27%) and addition of mouse (36%), and increased mean hours of use of keyboard (extra 40 min.) and mouse (extra 56 min.) among users was also reported. Time sitting >2 hours continuously increased by 9% to 33% of 2001 respondents. Improved was social support at work (not RSI related) but unchanged were other risk factors including psychological workload, decision latitude, the extent to which employees' ideas were listened to and the extent of employees' participation in decision making. 68% of 2001 survey respondents reported having pain/other symptoms in the last year, similar to P1 respondents. 40% of these reported their pain to the workplace, particularly if they considered pain a problem or had greater disability and poorer work function scores.

Among a cohort that participated in P1 and Q4 26% got better (13% resolved and 13% less severe/frequent pain), 54% stayed the same (9% still severe and frequent (chronic), 22% still mild, 23% remained symptom free) and 21% had increased pain (5% got worse and 16% had new pain). Overall this meant that more got better than worse, even though those who remained in the cohort were worse at baseline than those that did not continue. They had fewer wrist/hand (- 6%), more shoulder (+7%), and more neck (+12%) pain. In 2001, the majority reported that their pain was aggravated by work (yes, 57%; to some extent, 34%).

In path analyses on the cohort, RSI training and job task changes were both associated with significant ($p<0.1$) increases in decision latitude and reductions in disability, after taking account of demographic confounders (gender and age). Perhaps training gave employees some support to adjust their workload or work rhythm, taking breaks as needed and assuming more control over the process of their work.

Of additional interest, is that men were more likely than women to report decreases in decision latitude but increases in management support for RSI and persistence of poorer telephone types. Nevertheless, it remains hard to interpret such change over time in causal terms, with post-hoc explanations taking root to understand the relationships. At least, in the way we carried out modeling, different kinds of variables along the path are not conflated, nor can confounding by the usual demographic variables be a big problem. Such difficulty teasing out both intervention effects and directions in causality are unfortunately related to the complexity of relationships and practices in the workplace.

In our discussion of these results with labour and management of the company, they clearly articulated the different workplace pressures. During the period, the business thrived despite competitive pressures and major technological and organizational change occurred. In many ways, the fact that RSI/WMSD got marginally better and not worse is a testament to the commitment of the workplace parties, the extent to which they did implement the Ergonomic Policy, and their understanding that is that dealing with RSI/WMSD is a long term proposition. Some RSI Committee members see the need to not only maintain their activities but also push upstream into influencing technology change and job design (section G.3).

PUBLICATIONS RESULTING FROM COLLABORATIVE RESEARCH AT THE TORONTO STAR

EARLIER DATA COLLECTION EFFORTS IN COLLABORATIVE RESEARCH PROGRAM

Journal Articles

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Appendices

I. Ergonomic Policy latest version
II. Ergonomic Report/Workstation Assessment Form
III. Chart of Workstation Assessment
IV. Treatment Monitoring Questionnaire
V. Copy of Q4 2001 survey
VI. RSI 1993-2002 timeline

Toronto Star - Ergonomic Policy

Mission Statement

Our goal is to ensure that The Toronto Star continues to be an industry leader in the identification, treatment and prevention of Repetitive Strain Injuries (RSI) through the application of sound ergonomic principles in the workplace.

Objectives

1. Prevent the occurrence of RSI, by controlling employee exposure to the workplace risk factors that can cause or aggravate RSI;
2. Reduce the severity of RSI through timely reporting and early medical management; —
3. Ensure that all employees are informed about RSI and the workplace risk factors that can cause or aggravate RSI;
4. Promote continuous improvement in the technology and management practices to control exposure to workplace risk factors; and,
5. Ensure union/management leadership and employee involvement in controlling exposure to workplace risk factors.

Definitions

Ergonomics - The applied science that seeks to fit the job to the worker through the evaluation and design of the work environment in relation to human characteristics and interactions in the workplace.

Repetitive Strain Injuries (RSI), also known as Work-Related Musculoskeletal Disorders (WMSDs) and Cumulative Trauma Disorders (CTDs) - Disorders caused by repeated motions and exertions. The arms and hands are especially vulnerable but other parts of the upper body can also be affected. These injuries can involve nerves, blood vessels or tendons. Some different examples of RSI are (but not limited to) tendinitis, bursitis, carpal tunnel syndrome, epicondylitis, neck pain and low back pain.

Risk Factors

Ergonomic factors that must be considered in the identification and assessment of risks are the following:

(a) the physical demands of work, including
- force required,
- repetition,
- duration,
- work postures, and,
- local contact stresses.

/20

Employer Responsibilities

The Toronto Star and its managers, on an ongoing basis must:

- Take every precaution reasonable in the circumstances for the protection of the employees.
- Identify, prevent, eliminate and, when that is not practicable, minimize the risk of adverse health effects to workers from exposure to ergonomic risk factors.
- Ensure that a health and safety assessment is conducted whenever a change in the work environment is planned or occurs, or newly available information indicates that workers may be at risk of adverse health effects from exposure to ergonomic risk factors.
- Ensure a workstation assessment is completed upon employee request.
- Educate workers so that they will be able to identify risks, recognize early signs and symptoms of adverse health effects, know the procedures for reporting symptoms/ injuries, and be knowledgeable of The Toronto Star Ergonomic Policy.
- Ensure that employees are trained to work safely and to use any equipment in a safe and proper manner.
- Return employees injured by RSI to meaningful work, following The Toronto Star Return-to-Work policies and procedures.
- Implement engineering controls in preference to administrative controls, as far as is practicable. Personal protective equipment may only be used as a substitute for engineering or administrative controls if it provides an equal or higher level of protection of worker health and safety, and if it is used in circumstances in which engineering or administrative controls are not practicable.
- Plan for and ergonomically design new equipment and workstation layouts.
- Follow purchasing guidelines and design specifications as distributed by the RSI Committee.
- Involve the Manager, Health & Safety and Environment in any software decisions that may impact workflow.

Employee Responsibilities

A Toronto Star employee, on an ongoing basis, must:

- Work in a manner which is safe and which does not endanger himself, herself or any other person.
- Adhere to departmental health and safety rules.
- Promptly report all accidents and injuries to a supervisor or manager.
- Promptly report early signs, symptoms and ergonomic concerns to a supervisor or manager as per the attached flowchart. As well, if the situation involves signs/symptoms, the employee must report them to the health centre.
- Contact the Health Centre before receiving treatment for RSI and sign a waiver releasing information on the assessment and progress of treatment to The Toronto Star. * Please note that only full-time and regular part-time employees are entitled to receive treatment as agreed to under the collective agreement.
- If required to lose time from work due to RSI, keep in touch with departmental management and follow The Toronto Star Return-to-Work policies and procedures.
- Upon finding a hazard in the work place, report it as soon as possible to a supervisor or manager within the department. If a satisfactory response is not received within a reasonable period of time, notify a member of the Health and Safety Committee.

Ongoing Risk Evaluation

1. The employer must monitor, and evaluate at least annually, the effectiveness of the measures taken to comply with this policy. Any comparative data will be reviewed on an ongoing basis.
2. When deficiencies are identified, they must be corrected without undue delay.
3. Reporting systems will be maintained to ensure that measures have been effective.
4. The RSI committee will take a leadership role in monitoring the effectiveness of any ergonomic programs, policies or guidelines by reviewing trends in the ergonomic workstation assessment database.

Consultation

1. The employer will consult with the RSI committee, with respect to:
   - risk identification, assessment and control
   - the content and provision of worker education and training; and,
   - evaluation of measures taken to comply with this policy.

2. In addition, the employer will, in a timely manner, when performing a health and safety assessment, consult with
   - workers who are required to carry out the work being assessed, and
   - workers with signs or symptoms of adverse health effects resulting from exposure to ergonomic risk factors.

Ergonomic Report/Workstation Assessment

Name ______________ (First) ______________ (Last) Date ________ Day ________ Month ________ Year

Dept.______________________ Section______________________

Job Title______________________ Ergo Rep______________________

Experiencing Symptoms

☐ No
☐ Yes How long have you been experiencing symptoms? ______ Days ______ Weeks ______ Months ______ Years

Is pain/discomfort intermittent? ☐ YES ☐ NO
Do you think it is work-related? ☐ YES ☐ NO

Body Part(s) Rt/Lt/Both		Intensity of Pain/Discomfort Over the LAST WEEK				
☐ ☐ ☐	Neck	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Unbearable
☐ ☐ ☐	Shoulder	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Unbearable
☐ ☐ ☐	Elbow	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Unbearable
☐ ☐ ☐	Arm	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Unbearable
☐ ☐ ☐	Hand/wrist	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Unbearable
☐ ☐ ☐	Fingers	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Unbearable
☐ ☐ ☐	Thumb	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Unbearable
☐ ☐ ☐	Upper Back	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Unbearable
☐ ☐ ☐	Lower Back	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Unbearable
☐ ☐ ☐	Head	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Unbearable
☐ ☐ ☐	Other/ Specify ______	☐ None	☐ Mild	☐ Moderate	☐ Severe	☐ Unbearable

Issues	Assessment						Corrective Action Taken
☐ Posture	☐ Very good	☐ Good	☐ Fair	☐ Poor	☐ Very poor	☐ N/A	☐ Yes
☐ Monitor height	☐ Very good	☐ Good	☐ Fair	☐ Poor	☐ Very poor	☐ N/A	☐ Yes
☐ Monitor distance/placement	☐ Very good	☐ Good	☐ Fair	☐ Poor	☐ Very poor	☐ N/A	☐ Yes
☐ Glare/reflection	☐ Very good	☐ Good	☐ Fair	☐ Poor	☐ Very poor	☐ N/A	☐ Yes
☐ Reference document position	☐ Very good	☐ Good	☐ Fair	☐ Poor	☐ Very poor	☐ N/A	☐ Yes
☐ Chair adjustments	☐ Very good	☐ Good	☐ Fair	☐ Poor	☐ Very poor	☐ N/A	☐ Yes
☐ Keyboard height/placement/tilt	☐ Very good	☐ Good	☐ Fair	☐ Poor	☐ Very poor	☐ N/A	☐ Yes
☐ Mouse position	☐ Very good	☐ Good	☐ Fair	☐ Poor	☐ Very poor	☐ N/A	☐ Yes
☐ Telephone issues	☐ Very good	☐ Good	☐ Fair	☐ Poor	☐ Very poor	☐ N/A	☐ Yes
☐ General workstation layout	☐ Very good	☐ Good	☐ Fair	☐ Poor	☐ Very poor	☐ N/A	☐ Yes
☐ Breaks (15 min, lunch)	☐ Very good	☐ Good	☐ Fair	☐ Poor	☐ Very poor	☐ N/A	☐ Yes
☐ Mini Breaks (60s for every 20 minutes continuous)	☐ Very good	☐ Good	☐ Fair	☐ Poor	☐ Very poor	☐ N/A	☐ Yes

Work Organization Factors

☐ Non Standard Work Hours ☐ Overtime ☐ Short Staff
☐ Special Project ☐ Technical Difficulties ☐ Work Intensity/Deadlines
☐ Shared Workstation

Recommendations for Equipment Purchase: ______________________

____

Comments ______________________

____

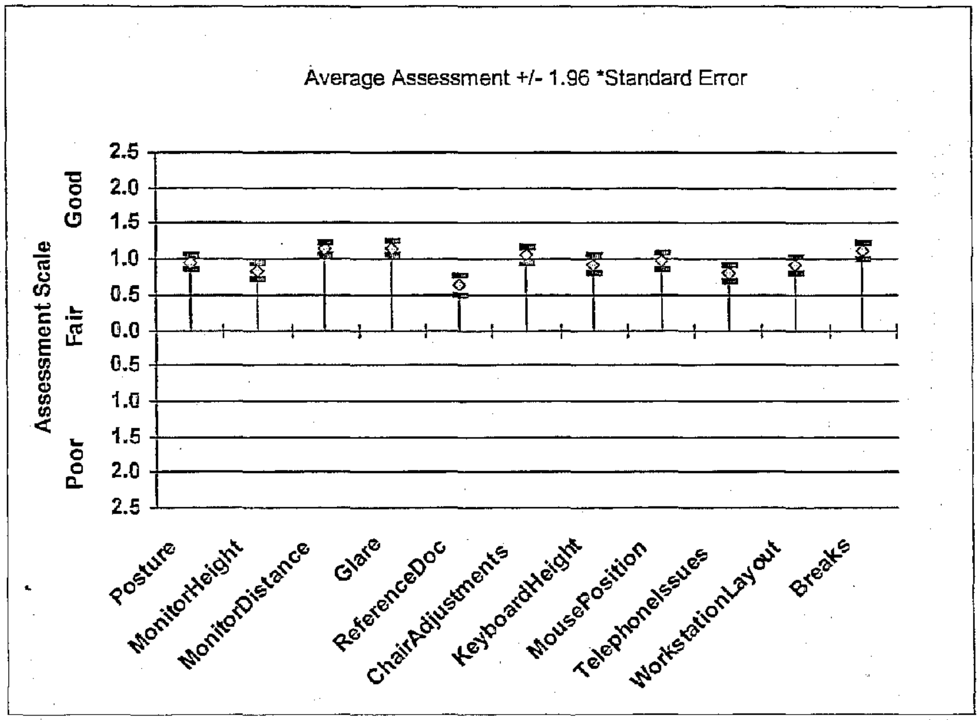
Follow-up

Date ________ Day ________ Month ________ Year /22 ☐ Completed ☐ Not Applicable

DISTRIBUTION: White – HR, Green – O.H.N., Canary - Supervisor, Pink – Ergo Rep, Gold - Othe

Chart of Workstation Assessment

01-Jan-01 To 31-Dec-03



Number of Workstations: 428

RSI Questionnaire

Treatment Monitoring

Please fill in today's date.

Date: ____ / ____ / ____
day month year

❐

Please ✓ box above if you would like your questionnaire photocopied and sent to you.

Can we make a copy of this questionnaire for your treating physiotherapist?

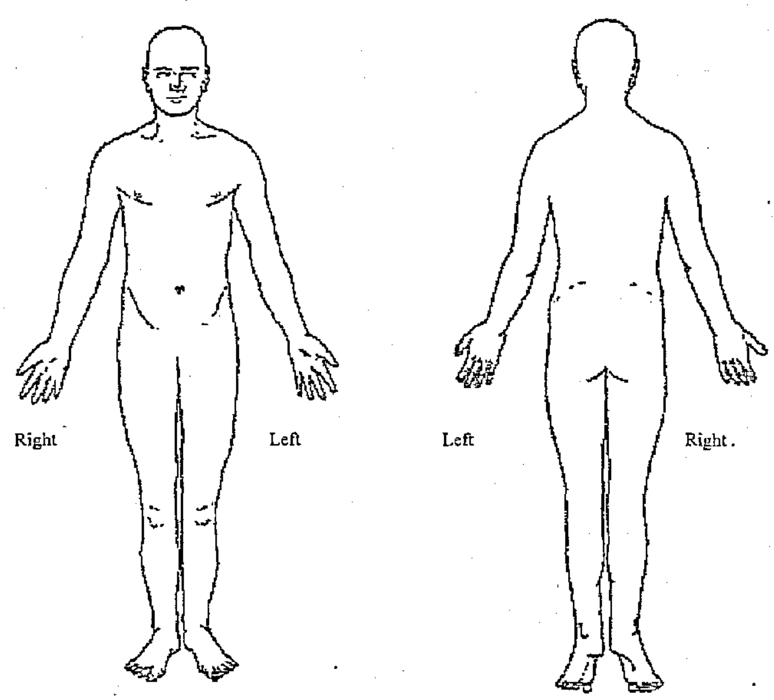
- ❐ Yes, you may make and give a copy to my physiotherapist.
- ❐ No.

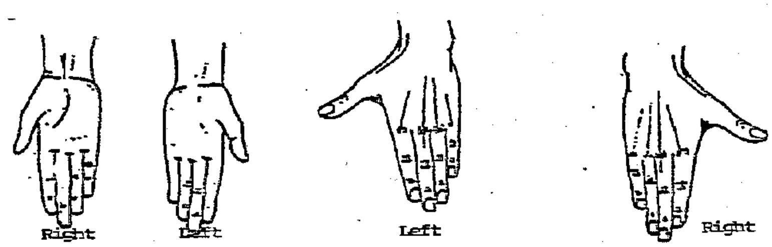
Section A

We would like to begin by asking you about the musculoskeletal (RSI) pain or discomfort (aching/tingling) you have had that brought you to the Health Centre. This pain or discomfort may be in your upper extremities (neck, shoulder, elbow, arm, hand), or back .

1. Please indicate what areas bother you by carefully shading in those areas in the drawings below. For each area that you shade in, write next to it the kind of discomfort you experience as follows:

P = Pain, Aching NT - Numbness/Tingling S = Swelling





2. Have you visited the Health Centre for this same pain/discomfort any other time in the last three months? (*check box)*

☐ YES ☐ NO

3. Please complete a column in the table below for each area that bothers you.

		Neck	Shoulder	Elbow/ Forearm	Wrist/ Hand	Back
Which side or area bothers you? *(circle number)*		1 LEFT 2 RIGHT 3 CENTRAL	1 LEFT 2 RIGHT	1 LEFT 2 RIGHT	1 LEFT 2 RIGHT	1 UPPER 2 LOWER
In what month and year did you first notice your pain or discomfort? *(write in number)*		MO. ___ YR. ___	MO. ___ YR. ___	MO.___ YR. ___	MO. ___ YR . ___	MO.___ YR. ___
How often have you had separate episodes in the last year? *(circle number)*	Pain is constant Daily One or more times a week One or more times a month Every 2-3 months Every 6 months or more	1 2 3 4 5 6	1 2 3 4 5 6	1 2 3 4 5 6	1 2 3 4 5 6	1 2 3 4 5 6
How long was each episode? *(circle number)*	Less than 1 hour 1 hour to 1 day More than 1 day to 1 week More than 1 week to 1 month More than 1 month to 5 months More than 6 months	1 2 3 4 5 6	1 2 3 4 5 6	1 2 3 4 5 6	1 2 3 4 5 6	1 2 3 4 5 6
According to the scale at right, how would you rate your pain or discomfort over the **last 7 days?** *(circle number)*	No discomfort Mild Moderate Severe Unbearable	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
According to the scale at right, in the **past year,** how bad was your **worst** pain or discomfort? *(circle number)*	No discomfort Mild Moderate Severe Unbearable	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
According to the scale at right, in the **past year,** on **average,** how intense was your pain or discomfort? *(circle number)*	No discomfort Mild Moderate Severe Unbearable	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Prior to your current pain or discomfort, did you ever have an accident or sudden injury to this area? *(If yes, please indicate year.)* ☐ YES → ☐ NO		YR.____	YR.____	YR.____	YR. ____	YR.____
Which area of discomfort brought you to the health unit/physio today?		☐	☐	☐	☐	☐

4. How would you rate your ability to do your usual daily activities (such as opening jars, writing, doing household chores) **over the last week?** *(check box)*

☐	☐	☐	☐	☐	☐	☐
1 Not difficult	2	3	4	5	6	7 Very difficult

Section B

Please complete this section if you have upper extremity pain or discomfort. Otherwise please go to Section C.

This questionnaire asks about your symptoms as well as your ability to perform certain activities. Please answer **every question**, based on your condition in the last week, by checking the appropriate box. If you did not have the opportunity to perform an activity in the past week, please make your **best estimate** as to which response would be the most accurate. It doesn't matter which hand or arm you use to perform the activity; please answer based on your ability regardless of how you perform the task.

Please rate your ability to do the following activities in the last week by checking the box below the appropriate response.

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. Open a tight or new jar.	☐	☐	☐	☐	☐
2. Do heavy household chores (e.g., wash walls, wash floors).	☐	☐	☐	☐	☐
3. Carry a shopping bag or briefcase.	☐	☐	☐	☐	☐
4. Wash your back.	☐	☐	☐	☐	☐
5. Use a knife to cut food.	☐	☐	☐	☐	☐
6. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	☐	☐	☐	☐	☐
7. Sleeping	☐	☐	☐	☐	☐

	NOT AT ALL	SLIGHTLY	MODERATELY	QUITE A BIT	EXTREMELY
8. During the past week, **to what extent** has your arm, shoulder or hand problem interfered with your normal social activities with family, friends or groups?	☐	☐	☐	☐	☐

	NOT LIMITED AT ALL	SLIGHTLY LIMITED	MODERATELY LIMITED	VERY LIMITED	UNABLE
9. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	☐	☐	☐	☐	☐

Please rate the severity of the following symptoms in the last week. *(check box)*

	NONE	MILD	MODERATE	SEVERE	EXTREME
10. Arm, shoulder or hand pain.	☐	☐	☐	☐	☐
11. Tingling (pins and needles) in your arm, shoulder or hand.	☐	☐	☐	☐	☐

The following questions relate to the impact of your upper extremity problem on **doing your usual work (including homemaking if that is your main work role)**. Please check the box that best describes your physical ability in the past week. Did you have any difficulty:

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
12. doing your usual work because of arm, shoulder or hand problem?	☐	☐	☐	☐	☐
13. using your usual technique for work?	☐	☐	☐	☐	☐
14. doing your work as well as you would like because of your arm, shoulder or hand problem?	☐	☐	☐	☐	☐

Section C

Please complete this section if you have back pain with or without pain going down your leg(s) from your back. Otherwise go to Section D.

When your back or leg hurts, you may find it difficult to do some of the things you normally do. This list contains some sentences that people have used to describe themselves when they have back pain or sciatica. You may find that some stand out because they describe you today. As you read the list, think of yourself today and check the one box below that best describes you.

		YES	NO
1.	I stay at home most of the time because of my back problem or leg pain (sciatica).	☐	☐
2.	I change position frequently to try and get my back or leg comfortable.	☐	☐
3.	I walk more slowly than usual because of my back problem or leg pain (sciatica).	☐	☐
4.	Because of my back problem, I am not doing any of the jobs that I usually do around the house.	☐	☐
5.	Because of my back problem, I use a handrail to get upstairs	☐	☐
6.	Because of my back problem, I lie down to rest more often.	☐	☐
7.	Because of my back problem, I have to hold onto something to get out of an easy chair.	☐	☐
8.	Because of my back, I try to get other people to do things for me.	☐	☐
9.	I get dressed more slowly than usual because of my back problem or leg pain.	☐	☐
10.	I only stand for short periods of time because of my back or leg pain.	☐	☐
11.	Because of my back problem, I try not to bend or kneel down.	☐	☐
12.	I find it difficult to turn over in bed because of my back problem or leg pain.	☐	☐
13.	My back or leg is painful almost all the time.	☐	☐
14.	I find it difficult to get out of a chair because of my back problem or leg pain (sciatica).	☐	☐
15.	My appetite is not very good because of my back pain.	☐	☐
16.	I have trouble putting on my socks/stockings) because of my back problem or leg pain (sciatica).	☐	☐
17.	I only walk short distances because of my back problem or leg pain (sciatica).	☐	☐
18.	I sleep less well because of my back problem.	☐	☐
19.	Because of my back pain, I get dressed with the help of someone else.	☐	☐
20.	I sit down for most of the day because of my back.	☐	☐
21.	I avoid heavy jobs around the house because of my back problem.	☐	☐
22.	Because of my back problem, I am more irritable and bad tempered with people than usual.	☐	☐
23.	Because of my back problem, I go up stairs more slowly than usual.	☐	☐
24.	I stay in bed most of the time because of my back problem or leg pain (sciatica).	☐	☐

Section D

Everyone please complete this section and the rest of the package.

In the past 4 weeks, how much of the time did your upper extremity/back pain or discomfort make it difficult to do the following aspects of your job? Please check the box below the appropriate response. If the activity described is not part of your job, check the box below NOT PART OF MY JOB and go on to the next item.

	DIFFICULT ALL THE TIME (100%)	DIFFICULT MOST OF THE TIME	DIFFICULT SOME OF THE TIME (50%)	DIFFICULT A SLIGHT BIT OF THE TIME	DIFFICULT NONE OF THE TIME (0%)	NOT PART OF MY JOB
1. Sticking to your work routine or schedule.	☐	☐	☐	☐	☐	☐
2. Working without extra breaks or rests (for example, because you were uncomfortable).	☐	☐	☐	☐	☐	☐
3. Lifting, carrying or moving objects at work .	☐	☐	☐	☐	☐	☐
4. Bending, twisting or reaching.	☐	☐	☐	☐	☐	☐
5. Using hand operated tools or equipment (for example, pen, drill, sander, keyboard or computer mouse).	☐	☐	☐	☐	☐	☐
6. Keeping your body in one position longer than 30 minutes at a time.	☐	☐	☐	☐	☐	☐
7. Keeping track of more than one task or project at the same time.	☐	☐	☐	☐	☐	☐
8. Concentrating on your work .	☐	☐	☐	☐	☐	☐
9. Remembering things having to do with your work.	☐	☐	☐	☐	☐	☐
10. Talking with people in person, in meetings or on the phone.	☐	☐	☐	☐	☐	☐
11. Helping others to get work done.	☐	☐	☐	☐	☐	☐
12. Controlling irritability or anger toward people when working.	☐	☐	☐	☐	☐	☐
13. Doing your work without making mistakes.	☐	☐	☐	☐	☐	☐
14. Satisfying those people who judge your work.	☐	☐	☐	☐	☐	☐
15. Finishing all your work.	☐	☐	☐	☐	☐	☐
16. Feeling a sense of accomplishment.	☐	☐	☐	☐	☐	☐

Section E

In the following questions, we'd like to know how your pain/discomfort affects you. For each of the following questions, please circle the number which corresponds to your certainty that you can now perform the following tasks.

a. How certain are you that you can decrease your pain quite a bit?

10 20 30 40 50 60 70 80 90 100

Very Uncertain — Moderately Uncertain — Very Certain

b. How certain are you that you can continue most of your daily activities?

10 20 30 40 50 60 70 80 90 100

Very Uncertain — Moderately Uncertain — Very Certain

c. How certain are you that you can keep pain from interfering with your sleep?

10 20 30 40 50 60 70 80 90 100

Very Uncertain — Moderately Uncertain — Very Certain

d. How certain are you that you can make a small-to-moderate reduction in your pain by using methods other than taking extra medication?

10 20 30 40 50 60 70 80 90 100

Very Uncertain — Moderately Uncertain — Very Certain

e. How certain are you that you can make a large reduction in your pain using methods other than taking extra medication?

10 20 30 40 50 60 70 80 90 100

Very Uncertain — Moderately Uncertain — Very Certain

Section F

SF-12 Health Survey

INSTRUCTIONS: These questions ask you for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities. Please answer every question by marking one box. If you are unsure about how to answer, please give the best answer you can.

1. In general, would you say your health is:

☐ Excellent ☐ Very Good ☐ Good ☐ Fair ☐ Poor

The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	Yes, Limited A Lot	Yes, Limited A Little	No, Not Limited At All
2. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	☐	☐	☐
3. Climbing several flights of stairs	☐	☐	☐

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

	YES	NO
4. Accomplished less than you would like	☐	☐
5. Were limited in the kind of work or other activities	☐	☐

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

	YES	NO
6. Accomplished less than you would like	☐	☐
7. Didn't do work or other activities as carefully as usual	☐	☐

8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

☐ Not at all ☐ A little bit ☐ Moderately ☐ Quite a bit ☐ Extremely

These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one that comes closest to the way you have been feeling. How much of the time during the past 4 weeks :

	All of the Time	Most of the Time	A Good bit of the Time	Some of the Time	A Little of the Time	None of the Time
9. Have you felt calm and peaceful?	☐	☐	☐	☐	☐	☐
10. Did you have a lot of energy?	☐	☐	☐	☐	☐	☐
11. Have you felt downhearted and blue?	☐	☐	☐	☐	☐	☐

12. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like vising with friends, relatives, etc.)?

☐ All of the time ☐ Most of the time ☐ Some of the time ☐ A little of the time ☐ None of the time

Section G

This last section will tell us a bit more about your discomfort. Please consider the discomfort that has brought you to the occupational health unit, or to physiotherapy when answering.

1. What have your health practitioner(s) told you the upper extremity/back pain or discomfort (or diagnosis) is? (*check appropriate boxes)*

   ☐ TENSION NECK SYNDROME
   ☐ ROTATOR CUFF TENDINITIS
   ☐ SHOULDER BURSITIS
   ☐ TENDINITIS OF HAND/WRIST
   ☐ CARPAL TUNNEL SYNDROME
   ☐ LATERAL EPICONDYLITIS
   ☐ DEGENERATIVE DISC DISEASE
   ☐ REPETITIVE STRAIN INJURY
   ☐ MY HEALTH PRACTITIONER(S) DOESN'T KNOW
   ☐ I WAS NOT TOLD
   ☐ OTHER (*please specify*) ________________________

2. Is this the first time you have had this kind of pain/discomfort?

   ☐ YES, THIS CURRENT EPISODE IS THE FIRST EPISODE I HAVE EVER HAD OF THIS KIND OF DISCOMFORT.
   ☐ NO, I HAVE HAD THIS DISCOMFORT IN THE PAST.

3. In the past, have you ever had to lose time from work (greater than one shift) due to the kind of pain/discomfort you are having now?

   ☐ YES
   ☐ NO

4. Prior to when you received this questionnaire (which was probably when you went to see the occupational health nurse) were you having treatment for your current discomfort/pain?

   ☐ YES, I WAS ALREADY RECEIVING TREATMENT (I.E., PHYSIOTHERAPY, CHIROPRACTIC, MASSAGE, MEDICATION FROM MY DOCTOR)
   ☐ NO, I WAS NOT RECEIVING ANY FORMAL HEALTH CARE/TREATMENT

5. Have you ever had surgery for muscle/joint discomfort (such as carpal tunnel surgery, or rotator cuff surgery, low back surgery) in you upper limbs, back or neck?

   ☐ YES, IF YES, PLEASE LIST: ____
   ☐ NO

6. Which health practitioner(s) have you visited for your upper extremity/back pain or discomfort? *(Please check appropriate boxes.)*

   ☐ FAMILY DOCTOR
   ☐ PHYSIOTHERAPIST
   ☐ COMPANY DOCTOR
   ☐ CHIROPRACTOR
   ☐ OCCUPATIONAL HEALTH NURSE
   ☐ MASSAGE THERAPIST
   ☐ ORTHOPAEDIC SURGEON (SPECIALIST)

☐ OTHER *(please specify)* ______________________________

7. Over the past week, how often have you had to take over the counter pain medications for your discomfort/pain (by "over the counter" we mean things you can buy without a prescription such as plain tylenol, aspirin, advil or ibuprofen)?

   ☐ NEVER
   ☐ SOME DAYS
   ☐ MOST DAYS (>3 DAYS/WEEK)
   ☐ ALL DAYS

8. Over the past week, how often have you had to take prescription medications (medication that required a prescription from your doctor)?

   ☐ NEVER
   ☐ SOME DAYS
   ☐ MOST DAYS (>3 DAYS/WEEK)
   ☐ ALL DAYS

9. Taking into account what you have been told about your upper limb, back pain or discomfort, do you think that you will get better soon, get better slowly, stay the same, never get better or get worse? *(check box)*

   ☐ GET BETTER SOON
   ☐ GET BETTER SLOWLY
   ☐ STAY THE SAME
   ☐ NEVER GET BETTER
   ☐ GET WORSE
   ☐ DON'T KNOW

10. How long do you think it will take for you to return to your usual activities? *(please specify)*

    ☐ LESS THAN 3 WEEKS
    ☐ 3 WEEKS OR MORE
    ☐ I DON'T KNOW

11. Your sex *(check box)*

    ☐ FEMALE
    ☐ MALE

12. What is your date of birth? ______/_______/ 19______
    DAY MONTH YEAR

Is there anything else you would like to tell us? If so, please use the space on the back of the questionnaire.

RSI Questionnaire

Fall, 2001

Please fill in today's date.

Date: ______/_______/_______
Day Month Year

135

A. We would like to begin by asking you a few questions about yourself.

1. Your sex (*check box*) ☐ Male ☐ Female

2. What is your date of birth? _____/_____/19___
Day Month Year

3. What is your marital status? (*check box*)

- ☐ Now married or living common law
- ☐ Single (never married)
- ☐ Widow or widower
- ☐ Separated or divorced

4. What is your height? (*please specify*) _______ feet _______ inches or ______ cm

B. Next we want to ask you about RSI (repetitive strain injury) and the RSI Program.

1. What do you think is/are the cause(s) of RSI? (*check one or more boxes*)

- ☐ Poorly designed work stations
- ☐ Poorly designed tools
- ☐ Lack of personal protective equipment
- ☐ Bad physical environmental conditions (e.g., too little or too much lighting)

- ☐ Tasks requiring a lot of physical force
- ☐ Too much computer keyboard use
- ☐ Too much mouse use
- ☐ Lack of task variability

- ☐ Having to meet deadlines
- ☐ Working without breaks
- ☐ Excessive work load
- ☐ Little job control
- ☐ Low job responsibility
- ☐ Conflicts at work
- ☐ Little social support at work
- ☐ Too much stress
- ☐ Lack of exercise
- ☐ Lack of training
- ☐ Poor posture
- ☐ Personality type
- ☐ Previous injury
- ☐ Previous medical problems
- ☐ Other (*please specify*)

2a. Did you participate in the 1998 Stop RSI Training Program at The Star? (*check box*)

- ☐ Yes
- ☐ No

If No, was RSI training part of your orientation? (*check box*)

- ☐ Yes
- ☐ No

2b. Do you think you need more/refresher training on RSI? *(check box)*

☐ Yes
☐ No

3. Do you feel that the Toronto Star management has been supportive in dealing with RSI? *(check box)*

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

4. Management encourages employees to promptly report physical symptoms arising from job tasks. *(check box)*

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

5. If I were recovering from an injury, management would make changes to my job or to my working hours to help me return to work. *(check box)*

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

6. Do you feel that your immediate supervisor is generally aware and concerned about RSI? *(check box)*

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

7. To what extent has the Toronto Star Stop RSI program achieved the following: *(check box)*

a) Reduced the severity of RSI through timely reporting and early medical management.

☐ Completely ☐ Mostly ☐ Moderately ☐ Slightly ☐ Not at all

b) Ensured that all employees are informed about RSI and RSI risk factors.

☐ Completely ☐ Mostly ☐ Moderately ☐ Slightly ☐ Not at all

c) Promoted continuous improvement in the technology and management practices to control exposure to workplace risk factors that can cause RSI.

☐ Completely ☐ Mostly ☐ Moderately ☐ Slightly ☐ Not at all

d) Ensured union/management leadership and employee involvement in controlling exposure to workplace risk factors that can cause RSI.

☐ Completely ☐ Mostly ☐ Moderately ☐ Slightly ☐ Not at all

C. Next we would like to ask you about your work.

1. How many years altogether have you worked in the newspaper business? *(please specify)*

_______ years _______ months

2. When did you begin working at the Toronto Star? *(please write in year)* → _____________

3. Are you: *(check box)*

- ☐ Full-time, permanent
- ☐ Part-time, permanent
- ☐ Temporary
- ☐ Contract
- ☐ On disability

4. Are you a member of SONG? *(check box)*

- ☐ Yes
- ☐ No

5. Please check the box indicating the section of the newspaper in which you work now. If you work in more than one section, check the box of the one in which the most time is spent.

- ☐ Circulation
- ☐ Communications
- ☐ Corporate Information Technology
- ☐ Editorial
- ☐ Finance and Administration
- ☐ Human Resources/Labour Relations
- ☐ Marketing Research
- ☐ Prepress
- ☐ Advertising
- ☐ Union

If you spend most of your time in advertising, are you now part of a team? *(check box)*

- ☐ Yes
- ☐ No

If Yes, what is your team name? *(please specify)* ➜ ______________________________

6. What is your job title? *(please specify)* ➜ ______________________________

7. How often during the last year did you work with deadlines? Please check the box with the one answer from each category that best describes your situation.

Daily	☐ Never	☐ Rarely	☐ Sometimes	☐ Much of the time	☐ Almost always
Weekly	☐ Never	☐ Rarely	☐ Sometimes	☐ Much of the time	☐ Almost always
Short Term	☐ Never	☐ Rarely	☐ Sometimes	☐ Much of the time	☐ Almost always
Long Term	☐ Never	☐ Rarely	☐ Sometimes	☐ Much of the time	☐ Almost always
Seasonal	☐ Never	☐ Rarely	☐ Sometimes	☐ Much of the time	☐ Almost always

8. I frequently have personal/family deadlines which increase the intensity at which I work.

☐ Strongly agree ☐ Agree ☐ Neither agree nor disagree ☐ Disagree ☐ Strongly disagree

9. At work, how long do you usually sit for a continuous period of time? *(check box)*

- ☐ Less than ½ hour
- ☐ ½ to 1 hour
- ☐ Between 1 hour and 2 hours
- ☐ More than 2 hours

10. On an average day at work, how much time do you spend on each of the following activities? *(check box, write in time spent in each category, indicating "NA" if not applicable)*

- ☐ Keyboarding? ________ hours
- ☐ Using a mouse? ________ hours
- ☐ Telephone? ________ hours

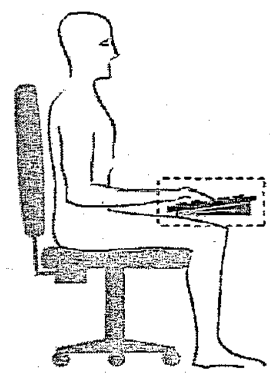
11. Which telephone(s) do you use at work? *(check all boxes that apply)*

- ☐ Hand-held receiver
- ☐ Headset
- ☐ Cell phone/car phone
- ☐ Shoulder-rest
- ☐ Hands free
- ☐ Do not use phone at work

The next three questions are trying to find out the relationship between the placement of the equipment you **use the most** and your body position.

12a. During normal use is your **keyboard** inside or outside the imaginary box pictured on the diagram to the right?

Use the figure to estimate the position of the box relative to your normal keyboarding position. *(check box)*



- ☐ Inside box ➔ Go to Question 13.
- ☐ Outside box
- ☐ Do not use keyboard ➔ Go to Question 14a.

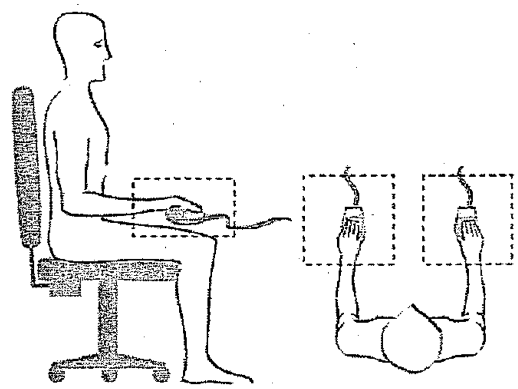
12b. If your keyboard is outside the box, is it: (*check all that apply*)

- ☐ Higher
- ☐ Lower
- ☐ Farther
- ☐ Closer
- ☐ To the side (I have to twist my body to type.)

13. I have a surface I can comfortably support my elbow/forearm or wrist upon when using the keyboard. *(check box)*

- ☐ Yes
- ☐ No

14a. During normal use is your **mouse** used inside or outside either of the imaginary boxes pictured on the diagram to the right? Use the figure to estimate the position of the box relative to your normal hand position. For right-handed people, look at the right box (and vice versa). (*check box*)



- ☐ Inside box ➾ Go to Question 15.
- ☐ Outside box
- ☐ Do not use a mouse ➾ Go to Question 16.

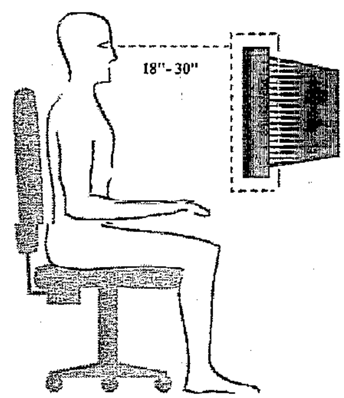
14b. If your mouse is outside the box, is it: *(check all that apply)*

- ☐ Higher
- ☐ Lower
- ☐ Farther
- ☐ Closer
- ☐ To the side (I have to reach sideways to use the mouse.)

15. I have a surface I can comfortably support my elbow/forearm or wrist upon when using the **mouse**. *(check box)*

- ☐ Yes
- ☐ No

16a. During normal use is the **screen** of your monitor inside or outside the imaginary box pictured on the diagram to the right? Use the figure to estimate the position of the box relative to your normal eye position (*check box*)



- ☐ Inside box ➾ Go to Question 17.
- ☐ Outside box
- ☐ Do not use monitor ➾ Go to Question 18.

16b. If your monitor is outside the box, is it: *(check all that apply)*

- ☐ Higher
- ☐ Lower
- ☐ Farther
- ☐ Closer
- ☐ To the side (I have to twist my neck to look at the monitor.)

17. Do you wear bi-focals, tri-focals, or half-lens glasses or contact lenses when working at your monitor? *(check box)*

- ☐ Yes
- ☐ No

18. Is the chair you usually use: *(check box)*

A. height adjustable?

- ☐ Yes
- ☐ No

B. equipped with armrests?

- ☐ Yes
- ☐ No

19. I work at more than one workstation during the week. *(check box)*

- ☐ Yes
- ☐ No If No, go to Question 21.

→ If Yes, how many? *(please specify)* ____________________

20. Has your workstation been assessed?

- ☐ Yes
- ☐ No If No, go to Question 21.

→ If Yes, by whom? *(check all boxes that apply)*

- ☐ Nurse
- ☐ Physiotherapist
- ☐ Trained representative from your department
- ☐ Other (please specify) ____________________

21. Now think about what changes have occurred to you at work **over the past 3 years** (or since your employment at The Star, whichever is most recent).

a) Which **equipment** changes have occurred? *(check all boxes that apply)*

- ☐ New workstation location
- ☐ New workstation
- ☐ New chair with arm rests
- ☐ Addition of wrist rest
- ☐ Addition of document holder
- ☐ Other *(please specify)*____________________

b) Which **computer** changes have occurred? *(check all boxes that apply)*

- ☐ New computer
- ☐ New monitor
- ☐ New keyboard
- ☐ Addition of mouse
- ☐ Increased use of mouse
- ☐ Increased use of computer
- ☐ New front end system
- ☐ New computer program(s) *(please specify top 3 primary use programs)*____________________
- ☐ Other *(please specify)*____________________

c) Which **job** changes have occurred? *(check all boxes that apply)*

- ☐ Different job title/job description
- ☐ Different tasks in same job
- ☐ Increased job responsibility
- ☐ Decreased job responsibility
- ☐ Less variety in job
- ☐ Broader job scope
- ☐ Service area contracted out
- ☐ Assigned to different group/work unit
- ☐ New team
- ☐ Change in co-workers
- ☐ Change in immediate supervisor
- ☐ Other *(please specify)*

To what extent do you face the following conditions at work: *(check appropriate boxes)*

24. Computer breakdown/freezes/crashes?

☐ Rarely ☐ Occasionally ☐ Sometimes ☐ Fairly often ☐ Very often

25. Slow response of computer?

☐ Rarely ☐ Occasionally ☐ Sometimes ☐ Fairly often ☐ Very often

26. How often to you face hostility or abuse from customers or clients?

☐ Rarely ☐ Occasionally ☐ Sometimes ☐ Fairly often ☐ Very often

D. Please check the box with the one answer that best describes **how strongly** you disagree or agree with the following statements.

1. I have to work together with other people to get the job done.

☐ Strongly disagree ☐ Disagree ☐ Neither agree nor disagree ☐ Agree ☐ Strongly agree

2. I can perform my tasks in any order and still get the job done.

☐ Strongly disagree ☐ Disagree ☐ Neither agree nor disagree ☐ Agree ☐ Strongly agree

3. I can take breaks when I want to.

☐ Strongly disagree ☐ Disagree ☐ Neither agree nor disagree ☐ Agree ☐ Strongly agree

4. To get the job done, it is important for me to coordinate my work with others.

☐ Strongly disagree ☐ Disagree ☐ Neither agree nor disagree ☐ Agree ☐ Strongly agree

5. Teamwork is not very important in my job.

☐ Strongly disagree ☐ Disagree ☐ Neither agree nor disagree ☐ Agree ☐ Strongly agree

6. To get my job done, it is important to do tasks in a specific order.

☐ Strongly disagree ☐ Disagree ☐ Neither agree nor disagree ☐ Agree ☐ Strongly agree

Please note that the following answer choices begin with strongly **agree** and end with strongly **disagree**.

7. My job requires that I learn new things.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

8. My job requires a high level of skill.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

9. My job allows me freedom to decide how I do my work.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

10. My job requires that I do things over and over.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

11. My job is very hectic.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

12. I am free from conflicting demands that others make.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

13. My job security is good.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

14. My job requires a lot of physical effort.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

15. I have a lot of say about what happens on my job.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

16. I am exposed to hostility or conflict from the people with whom I work.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

17. My supervisor is helpful in getting the job done.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

18. The people with whom I work are helpful in getting the job done.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

19. My job requires working very hard.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

20. I am asked to do an excessive amount of work.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

21. I have enough time to get the job done.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

22. There are enough people in my work area to get the job done.

☐ Strongly agree ☐ Agree ☐ Neither agree or disagree ☐ Disagree ☐ Strongly disagree

23. How satisfied are you with your job?

☐ Very satisfied ☐ Somewhat satisfied ☐ Not too satisfied ☐ Not at all satisfied

E. Now, we would like you to indicate **how often** certain things happen at your job. Please check the box with the one answer that best describes how often things happen at your job.

1. How often are you clear on what your job responsibilities are?

☐ Rarely ☐ Occasionally ☐ Sometimes☐ Fairly often ☐ Very often

2. How often can you predict what others will expect of you on the job?

☐ Rarely ☐ Occasionally ☐ Sometimes☐ Fairly often ☐ Very often

3. How much of the time are your work objectives well-defined?

☐ Rarely ☐ Occasionally ☐ Sometimes☐ Fairly often ☐ Very often

4. How often are you clear about what others expect of you on the job?

☐ Rarely ☐ Occasionally ☐ Sometimes☐ Fairly often ☐ Very often

F. And these are the final questions we want to ask you about your work.

1. How much influence do you have over the availability of supplies and equipment you need to do your work? *(check appropriate box)*

☐ Very little ☐ Little ☐ A moderate amount ☐ Much ☐ Very much

2. How much influence do you have over the availability of the information you need to do your work? *(check box)*

☐ Very little ☐ Little ☐ A moderate amount ☐ Much ☐ Very much

3. How frequently do workers take part in decision making in the workplace? *(check box)*

☐ Often ☐ Sometimes ☐ Rarely ☐ Never/Almost never

4. I feel employees' ideas/opinions are listened to by management. *(check box)*

☐ Strongly Disagree ☐ Disagree ☐ Neither agree or disagree ☐ Agree ☐ Strongly agree

5. Health and safety is considered equally with productivity and quality goals in management thinking. *(check box)*

☐ Often ☐ Sometimes ☐ Rarely ☐ Never/Almost never

G. Now we would like to ask you about your health.

1. Have you had any pain or discomfort (aching/tingling) in your neck, shoulder, elbow, arm or wrist/hand within the last year? *(check box)*

☐ Yes
☐ No If No, go to Section J, pg. 17.

2. How often have you had separate episodes in the last year? *(check box)*

☐ Pain is constant
☐ Daily
☐ One or more times a week
☐ One or more times a month
☐ Every 2-3 months
☐ Every 6 months or more

3. How long was each episode? *(check box)*

☐ Less than 1 hour
☐ 1 hour to 1 day
☐ More than 1 day to 1 week
☐ More than 1 week to 1 month
☐ More than 1 month to 5 months
☐ More than 6 months

4. How would you rate your upper limb (neck, shoulder, elbow, arm or wrist/hand) pain or discomfort over the **last 7 days?** *(check box)*

☐ No discomfort
☐ Mild
☐ Moderate
☐ Severe
☐ Unbearable

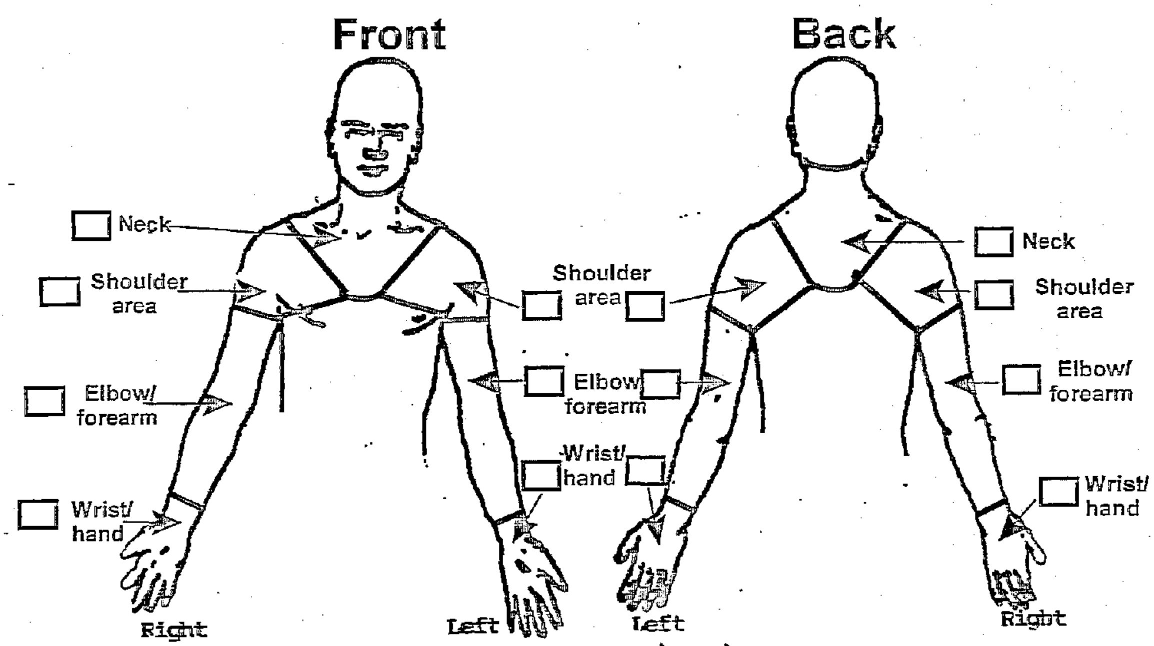
5. In the **past year**, how bad was your **worst** upper limb pain or discomfort? *(check box)*

- ☐ No discomfort
- ☐ Mild
- ☐ Moderate
- ☐ Severe
- ☐ Unbearable

6. In the **past year**, on **average**, how intense was your upper limb pain or discomfort? *(check box)*

- ☐ No discomfort
- ☐ Mild
- ☐ Moderate
- ☐ Severe
- ☐ Unbearable

7. Please indicate the areas in which you have pain by checking the boxes next to the diagrams below.



8. If your pain or discomfort is in more than one area, please indicate which one has the most impact on you. *(check box)*

☐ Neck ☐ Shoulder ☐ Elbow/Forearm ☐ Wrist/Hand

9. Do you consider your pain or discomfort to be a "problem"? *(check box)*

- ☐ Yes
- ☐ No

10. In the **past year** how has ***your experience*** of upper limb pain or discomfort changed? Please check one box below to indicate the change.

Is it:

Much worse					No change					Much better
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
0	1	2	3	4	5	6	7	8	9	10

11. In thinking about your response to Question 10, how much did each of the following contribute to your response? *(check box)*

	Very little	Little	A moderate amount	Much	Very much
Degree to which your symptoms changed.	☐	☐	☐	☐	☐
Degree to which you have changed your life.	☐	☐	☐	☐	☐
Degree to which you learned to live with symptoms.	☐	☐	☐	☐	☐

12. In the past year, which health practitioner(s) have you visited for your upper limb pain or discomfort? *(please check appropriate boxes)*

☐ Family doctor
☐ Physiotherapist at The Star
☐ Physiotherapist outside of The Star
☐ Company doctor
☐ Chiropractor
☐ Occupational health nurse
☐ Massage therapist
☐ Orthopaedic surgeon (specialist)
☐ Other *(please specify)* ______________________________

13. Which healthcare practitioner listed above did you see most often for your upper limb pain or discomfort? *(please specify)*

____

14. Have you taken up activities, received treatments or figured out strategies to control your pain/symptoms? *(check box)*

☐ Yes If Yes, can you describe them?
☐ No

If Yes, please check the appropriate boxes below to indicate what you have tried.

☐ Self education/instruction
☐ Exercises (e.g., pilates, yoga)
☐ Relaxation techniques
☐ Posture changes
☐ Physical treatments (e.g., heat, ice)
☐ Changes to workstation
☐ Changes to job description

☐ Medications
☐ Splints and other devices (e.g., braces, tennis elbow strap)
☐ Injections
☐ Surgery
☐ Other *(please specify)* ______________________________

15. In the following questions, we'd like to know how your upper limb pain or discomfort (shortened to pain below) affects you. For each of the following questions, please circle the number which corresponds to your certainty that you can now perform the following tasks.

a. How certain are you that you can decrease your pain quite a bit?

10 20 30 40 50 60 70 80 90 100

Very Uncertain — Moderately Uncertain — Very Certain

b. How certain are you that you can continue most of your daily activities?

10 20 30 40 50 60 70 80 90 100

Very Uncertain — Moderately Uncertain — Very Certain

c. How certain are you that you can keep pain from interfering with your sleep?

10 20 30 40 50 60 70 80 90 100

Very Uncertain — Moderately Uncertain — Very Certain

d. How certain are you that you can make a small-to-moderate reduction in your pain by using methods other than taking extra medication?

10 20 30 40 50 60 70 80 90 100

Very Uncertain — Moderately Uncertain — Very Certain

e. How certain are you that you can make a large reduction in your pain using methods other than taking extra medication?

10 20 30 40 50 60 70 80 90 100

Very Uncertain — Moderately Uncertain — Very Certain

16. Prior to your current pain or discomfort, did you ever have an accident or sudden injury to the same area? *(check box)*

☐ Yes
☐ No

17. Does the work you do during the day increase your level of pain enough that it is difficult to carry out your responsibilities at home? *(check box)*

☐ Yes
☐ No

18. Do you think reporting RSI symptoms at work would affect (or has affected) your job? (check box)

☐ Yes
☐ No
☐ Don't know

→ If Yes, in what way? *(check box)*

☐ In a positive way
☐ In a negative way

19. Do you think your upper limb (neck, shoulder, elbow, arm or wrist/hand) pain or discomfort was caused or aggravated by your work? *(check box)*

☐ Yes
☐ No
☐ To some extent

20. Did you report your upper limb pain or discomfort to your workplace? *(check box)*

☐ Yes
☐ No

→ If Yes, what has been your supervisor's reaction to your upper limb pain or discomfort? *(check appropriate boxes)*

☐ He/she blames me for the problem.
☐ He/she is supportive and helpful.
☐ He/she is angry that I am off work.
☐ He/she does not believe that anything is wrong with me.
☐ He/she is eager for me to return to work.
☐ He/she has had no reaction.
☐ None of the above
☐ Don't know

21. Do the activities you do at home increase your level of pain enough that it is difficult to carry out your responsibilities at work? *(check box)*

☐ Yes
☐ No

H. This section asks about your symptoms as well as your ability to perform certain activities. Please answer **every question**, based on your condition in the last week, by checking the appropriate box. If you did not have the opportunity to perform an activity in the **past week**, please make your **best estimate** as to which response would be the most accurate. It doesn't matter which hand or arm you use to perform the activity; please answer based on your ability regardless of how you perform the task.

Please rate your ability to do the following activities in the last week by checking the box below the appropriate response.

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
1. Open a tight or new jar.	☐	☐	☐	☐	☐
2. Do heavy household chores (e.g., wash walls, wash floors).	☐	☐	☐	☐	☐
3. Carry a shopping bag or briefcase.	☐	☐	☐	☐	☐
4. Wash your back.	☐	☐	☐	☐	☐
5. Use a knife to cut food.	☐	☐	☐	☐	☐
6. Recreational activities in which you take some force or impact through your arm, shoulder or hand (e.g., golf, hammering, tennis, etc.).	☐	☐	☐	☐	☐
7. Sleeping.	☐	☐	☐	☐	☐

	NOT AT ALL	SLIGHTLY	MODERATELY	QUITE A BIT	EXTREMELY
8. During the past week, **to what extent** has your arm, shoulder or hand problem interfered with your normal social activities with family, friends or groups?	☐	☐	☐	☐	☐

	NOT LIMITED AT ALL	SLIGHTLY LIMITED	MODERATELY LIMITED	VERY LIMITED	UNABLE
9. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	☐	☐	☐	☐	☐

Please rate the severity of the following symptoms in the last week. *(check box)*

	NONE	MILD	MODERATE	SEVERE	EXTREME
10. Arm, shoulder or hand pain.	☐	☐	☐	☐	☐
11. Tingling (pins and needles) in your arm, shoulder or hand.	☐	☐	☐	☐	☐

The following questions relate to the impact of your upper extremity problem on **doing your usual work (including homemaking if that is your main work role)**. Please check the box that best describes your physical ability in the past week. Did you have any difficulty:

	NO DIFFICULTY	MILD DIFFICULTY	MODERATE DIFFICULTY	SEVERE DIFFICULTY	UNABLE
12. doing your usual work because of arm, shoulder or hand problem?	☐	☐	☐	☐	☐
13. using your usual technique for work?	☐	☐	☐	☐	☐
14. doing your work as well as you would like because of your arm, shoulder or hand problem?	☐	☐	☐	☐	☐

I. In the **past 4 weeks**, how much of the time did your upper extremity/back pain or discomfort make it difficult to do the following aspects of your job? Please check the box below the appropriate response. If the activity described is not part of your job, check the box below NOT PART OF MY JOB and go on to the next item.

	DIFFICULT ALL THE TIME (100%)	DIFFICULT MOST OF THE TIME	DIFFICULT SOME OF THE TIME (50%)	DIFFICULT A SLIGHT BIT OF THE TIME	DIFFICULT NONE OF THE TIME (0%)	NOT PART OF MY JOB
1. Sticking to your work routine or schedule.	☐	☐	☐	☐	☐	☐
2. Working without extra breaks or rests (for example, because you were uncomfortable).	☐	☐	☐	☐	☐	☐
3. Lifting, carrying or moving objects at work.	☐	☐	☐	☐	☐	☐
4. Bending, twisting or reaching.	☐	☐	☐	☐	☐	☐
5. Using hand operated tools or equipment (for example, pen, drill, sander, keyboard or computer mouse).	☐	☐	☐	☐	☐	☐
6. Keeping your body in one position longer than 30 minutes at a time.	☐	☐	☐	☐	☐	☐
7. Keeping track of more than one task or project at the same time.	☐	☐	☐	☐	☐	☐
8. Concentrating on your work.	☐	☐	☐	☐	☐	☐
9. Remembering things having to do with your work.	☐	☐	☐	☐	☐	☐
10. Talking with people in person, in meetings or on the phone.	☐	☐	☐	☐	☐	☐

	DIFFICULT ALL THE TIME (100%)	DIFFICULT MOST OF THE TIME	DIFFICULT SOME OF THE TIME (50%)	DIFFICULT A SLIGHT BIT OF THE TIME	DIFFICULT NONE OF THE TIME (0%)	NOT PART OF MY JOB
11. Helping others to get work done.	☐	☐	☐	☐	☐	☐
12. Controlling irritability or anger toward people when working.	☐	☐	☐	☐	☐	☐
13. Doing your work without making mistakes.	☐	☐	☐	☐	☐	☐
14. Satisfying those people who judge your work.	☐	☐	☐	☐	☐	☐
15. Finishing all your work.	☐	☐	☐	☐	☐	☐
16. Feeling a sense of accomplishment.	☐	☐	☐	☐	☐	☐

J. 1. What other initiatives could be taken at the Toronto Star to deal with RSI? *(please specify)*

2. Is there anything else you would like to tell us? If so, please use the space below.

Thank you for completing this questionnaire.

RSI AT THE STAR 1993-PRESENT

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Company Events	Star articles about RSI	J. Honderich as new publisher	Boston Consulting Group review	Sink or Swim implementation
WSIB RSI Burden				
First Aid	3	8	24	23
Lost Time	5	11	7	3
Lost Days	455	821	214	59
RESPONSES Structures	VDT Committee	RSI Specialist appointed in editorial	RSI Watch Committee forms	H&S Committee discuss RSI issues
Education	RSI Video circulated	RSI article in StarBeat		
Equipment/ Workspace	The Human Factor, Inc. hired (workstation assessments)	Management encouraged to consider ergonomics when buying equipment.		[Blanket washers at Vaughan to 1997]
Healthcare			$1500/yr. allocated per employee for treatment Free EAP established	
Research			Agreement to conduct research with IWH	IWH Phase I questionnaire

RSI AT THE STAR 1993-PRESENT

[illegible]	[illegible]	[illegible]
Hay Group employee survey. Star/SONG bargaining begins. Team pilot in advertising.	RTW Policy released	Advertising moves to 4th floor. Star signs deal with CCI for integrated software system.
[illegible]	[illegible]	[illegible]
30	25	14
6	1	1
169	37	13
Manager, Health & Safety and Environment hired with expertise in ergonomics	Letter of Agreement from Star re RSI Program. Ergonomics Policy finalized. RSI reporting procedure developed. RSI Committee formed.	
H&S hourly exercise reminder program attempted. Four RSI presentations completed in circulation.		StarBeat article on STOP RSI training program. STOP RSI training begins.
		Workstation assessments begin
		On-site physiotherapy clinic opens
IWH Phase II research	Release of IWH Phase II research results. IWH Phase III research begins. Distribution of IWH questionnaire to sub-sample of depts.	
[illegible]	[illegible]	[illegible]

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RSI AT THE STAR 1993-PRESENT

Hay Group circ. Survey. Under staffing raised as RSI concern. Circ. moves to 3rd floor. Advertising team training begins. GTA Today launched.

Circulation outsourced. Star/SONG bargaining begins.

29	16	[illegible]
5	0	1
283	0	79

On-site physio representative joins RSI Committee

"RSI is Real" video

Medisys Health Group hired for audit of Star's medical and claims management plus return to work

New nurse coordinator hired in Health Centre

IWH cross-sectional survey distributed

Presentation of IWH Phase III results

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DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service
Centers for Disease Control
and Prevention (CDC)

Memorandum

Date: January 20, 2004

From: Michael J. Galvin, Ph.D., Program Official
Office of Extramural Programs, NIOSH, E-74

Subject: Final Report Submitted for Entry into NTIS for Grant 5R01OH003708-03.

To: William D. Bennett
Data Systems Team, Information Resources Branch, EID, NIOSH, P03/C18

The attached final report has been received from the principal investigator on the subject NIOSH grant. If this document is forwarded to the National Technical Information Service, please let us know when a document number is known so that we can inform anyone who inquires about this final report.

Any publications that are included with this report are highlighted on the list below.

Attachment
cc: Sherri Diana, EID, P03/C13

List of Publications

Wells R, Van Eerd D: Force As An Agent: Exposure Analysis in Ergonomic Epidemiology. In: Proceedings fo X2001, Exposure Assessment in Epidemiology and Practice, National Institute of Working Life, pp. 30-32, June 10-13, 2001

PUBLICATIONS RESULTING FROM COLLABORATIVE RESEARCH AT THE TORONTO STAR
Journal Articles

Beaton DE, Tarasuk V, Katz IN, Wright JG, Bombardier C: " Are you better?" A qualitative study of the meaning of recovery. Arthritis Care & Research 45:270-279,2001.

Swift M, Cole DC, Beaton DE, Manno M, Worksite Upper Extremity Group: Health care utilization and workplace interventions for neck and upper limb problems among newspaper workers. JOEM 42(3):265-275,2001.

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Wells R, Cole D, Worksite Upper Extremeity Group (2001) Intervention in Computer Intense Work. In: Proceedings of the 2nd Conference, Prevention of Muscle Disordrs in Computer Users (PROCID), (eds. L Sansdsjo, R Kadafors), National Institute for Working Life, West, pp. 119-125, March 8-10, 2001

Title: Wmsd--evaluating Interventions Among Office Workers
Investigator: Donald C. Cole
Affiliation:
City & State: ,
Telephone: (416) 927-2027 X 2166
Award Number: 5R01OH003708-03
Start & End Date: 9/30/1999-9/29/2003
Total Project Cost: 290074
Program Area:
Key Words: intervention, musculoskeletal disorders, work organization

Final Report Abstract:

ABSTRACT

Goal: To demonstrate the effectiveness of a workplace program for primary, secondary and tertiary prevention of work-related musculoskeletal disorders (WMSD) of the neck and upper extremity.

Aims:

I. To document the nature and timing of the interventions undertaken by the workplace parties (labor and management) as part of their commitment to a multipronged "RSI Program" in an office workplace.

2. To measure changes in awareness of WMSD prevalence, knowledge of WMSD risk factors and management attitudes towards WMSD.

3. To measure changes in exposure to physical and psychological risk factors for WMSD and WMSD symptoms among employees undergoing reorganization and a relative control group to assess the impact of an ergonomically informed reorganization process. 4. To assess whether the RSI Program resulted in a workforce wide reduction in self- reported exposures to physical and psychological risk factors for WMSD with a concomitant reduction in the self-reported period prevalence and severity of WMSD-related symptoms and their associated disability. -

5. To implement and evaluate an enhanced workplace WMSD surveillance system.

6. To model changes in rates of health care utilization and associated costs for WMSD and determine whether the RSI Program resulted in reductions in these measures.

Importance to occupational safety & health: interventions and longitudinal studies of the musculoskeletal health are sorely needed to the Evaluation of workplace ergonomic impact of work re-organization efforts on inform workplace parties and policy makers.

Approach: A prospective, longitudinal study using mixed methods. Qualitative research based on document review, worksite participation, and interviews was matched with quantitative research using surveys, clinical questionnaires, administrative data bases and intensive exposure assessment methods. Analyses of change used a variety of approaches including trend descriptions, trajectory analyses and path analyses.

Findings:

The workplace parties built on earlier research to develop an innovative Ergonomic Policy. Special RSI/WMSD training sessions were held in all departments, with 58% of 2001 survey (Q4) respondents remembering these sessions and another 11% indicating that they received training on RSI/WMSD as part of their orientation. 90% ofQ4 respondents felt that The Toronto Star RSI Program had completely to moderately "ensured that all employees are informed about RSI". Compared to our earlier PI 1996 survey, significantly greater endorsement of relevant responses as to potential causes of RSI/WMSD were observed e.g., workstation, tools, breaks, keyboarding, workload, exercise and posture, at the same time that "lack of training" was mentioned less frequently. Further, 74% agreed or strongly agreed (vs. 64% in 1996) that Toronto Star management were supportive in dealing with RSI though proportions indicating that their

The iImmediate supervisor was aware and concerned about RSI and the proportion of respondents who disagreed that "1 can take breaks when I want to" remained unchanged.

Among a small group of predominantly advertising employees undergoing direct measures, we observed reductions in extreme mouse positions (horizontal and vertical), fewer monitors to the side with less head rotation, and fewer extreme head tilts, the last despite monitor heights being generally higher. Increases in keyboard time and post-reorganization mousing time were positively associated with changes in employee pain among those undergoing reorganization into teams. Informal observations suggested that employees' jobs had changed little except for increased use of computers through introduction of new software.

The RSI Program was associated with some positive changes in self-reported exposures to physical and psychological WMSD risk factors. The proportion reporting equipment inside a preferred location increased between PI in 1996 and and Q

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Brixey, S.A., Paik, S., Evans, D.E. and Vincent, J.H. (2002), Experimental studies to develop new aerosol samplers and methods for their evaluation, Journal of Environmental Monitoring, 4, 633-641.

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*Dr. Gates was awarded $2000 for best contribution to JAMDA in 2002

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INSTITUTE
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December 23, 2003

Mary Ann P. Monroe
Acquistion and Assistance Field Branch, PGO
Centers for Disease Control and Prevention
626 Cochrans Mill Road
Pittsburgh, PA 15236-0070

RE: **Grant Number**: 5 RO1 OH03708-03
Project Title: WMSD: Evaluating Interventions Amoung Office Workers

Dear Ms. Munroe:

Enclosed is the Final Performance Report and relevant publications for the above project. In addition to the original, we have included two copies of the report along with three copies of each of the reprints, as outlined in the guidelines.

The Financial Status Report and Equipment Inventory were submitted to NIOSH on December 9th via courier.

Please note that no inventions were conceived under this grant.

I trust that all the documentation is in order. If you have any questions or concerns, please do not hesitate to contact me at your convenience.

Sincerely,

Donald C. Cole, M.D., M.Sc., FRCP(C)
Principal Investigator

Research Excellence Advancing Employee Health