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SUMMARY

In 1992 the National Council of Social Security Administration Field Operations Locals of the American Federation of Government Employees requested that the National Institute for Occupational Safety and Health (NIOSH) conduct a Health Hazard Evaluation (HHE) of work-related musculoskeletal disorders (WMD's) and job stress among teleservice representatives at Social Security Administration Teleservice Centers (TSC's). In 1993 NIOSH conducted a cross-sectional study to evaluate the association between specific work conditions, WMD's, perceived physical and mental exhaustion, and job dissatisfaction at two TSC's. The study covered teleservice representatives, who respond to toll-free calls for assistance. This involves a computer or manual search for information, and data entry using keyboards. One facility (Boston, Massachusetts) had adjustable furniture at the workstations; the other facility (Fort Lauderdale, Florida) did not. A questionnaire survey and ergonomic evaluation was conducted at both facilities to determine WMD's and their risk factors, as well as job stress.

One hundred and eight of the one hundred and fourteen (95%) employees present on the day of the survey at the two facilities participated, thirty one in Boston and seventy seven in Fort Lauderdale. Seventy-three (68%) participants reported symptoms meeting the case definition for an upper extremity, neck, or back WMD. Neck symptoms (44%) were the most frequently reported, followed by shoulder symptoms (35%), back symptoms (33%), hand-wrist symptoms (30%), and elbow symptoms (20%). Teleservice representatives in the Fort Lauderdale center had a higher prevalence of WMD's (78%) as compared to the Boston TSC representatives (42%).

Based on multiple logistic regression analyses, the following work-related variables were found to be associated ($p<.05$) with WMD symptoms:

- For **neck WMD's**: (1) chair discomfort, and (2) perceived workload variability (continually changing workload).
- For **shoulder WMD's:** (1) perceived non-optimally adjusted desk height, (2) Fort Lauderdale location, and (3) perceived non-optimally adjusted VDT screen.
- For **Elbow WMD's:** perceived non-optimally adjusted chair.
- For **Hand-wrist WMD's**: using the telephone more than eight hours per day. (Since TSC representatives use headsets, this association probably reflects overtime hours rather than phone use per se.)
- For **back WMD's**: (1) perceived non-optimally adjusted chair, and (2) perceived lack of job control.

Three indicator variables suggested high levels of job stress at both facilities. Seventy-five percent of the employees were "often" or "very often" physically exhausted at the end of the day. Ninety-two percent were "often" or "very often" mentally exhausted at the end of the day. Fifty-eight percent reported that

they were " not too satisfied" or "not at all satisfied" with their job. Physical and mental exhaustion, but not job dissatisfaction were of greater concern in Fort Lauderdale than in Boston.

Based on multiple regression analyses perceived physical and mental exhaustion, and job dissatisfaction were significantly ($p<.05$) associated with the following work-related variables.

- For **physical and mental exhaustion**: (1) perceived workload variability (continually changing workload during the day), (2) perceived lack of influence and control in policies, and (3) perceived lack of future certainty.
- For **job dissatisfaction**: (1) perceived lack of future certainty, (2) perceived non-optimally adjusted keyboard, (3) perceived poor supervision, and (4) perceived non-optimally adjusted VDT screen.

This study suggests a comprehensive approach to the prevention of WMD's, which addresses both ergonomics and work organizational elements, has the greatest likelihood of being successful in reducing the magnitude and severity of WMD's.

A high prevalence of symptoms suggestive of work-related musculoskeletal disorders was found at the Social Security Administration Teleservice Centers in Boston, Massachusetts, and in Fort Lauderdale, Florida. Suboptimal ergonomic conditions were associated with neck, shoulder, elbow, and back WMD's. Suboptimal ergonomic conditions were also associated with increased job dissatisfaction. Perceived increased workload variability and lack of job control were associated with the occurrence of neck and back WMD's respectively. WMD's were more frequently reported by teleservice representatives at the center with older furniture and sub-optimal ergonomic conditions. WMD's may be prevented by improving ergonomic conditions at workstations, controlling the workload variability, and by limiting overtime work-hours.

Keywords: SIC 9441 (Administration of Social, Manpower, and Income Maintenance Programs), video display terminals, office automation, ergonomics, musculoskeletal disorders, cumulative trauma disorders, repetitive motion disorders, psychosocial, work stress.

INTRODUCTION

In September 1992, the National Institute for Occupational Safety and Health (NIOSH) received a request from the National Council of Social Security Administration Field Operations Locals (NCSSAFOL) of the American Federation of Government Employees (AFGE) to conduct a health hazard evaluation (HHE) at Social Security Administration (SSA) Teleservice Centers (TSC's) nationwide. The request stated concerns regarding work-related musculoskeletal disorders (WMD's) of the back, neck, and upper extremities and job stress issues, including electronic monitoring. On November 23, 1992, NIOSH investigators met with NCSSAFOL and SSA representatives in Baltimore, Maryland, to discuss the HHE and to conduct a general walk-through inspection of the Baltimore TSC. The purpose of this tour was to familiarize the NIOSH investigators with TSC work practices and workstation design features. As a result of this meeting, five TSC's were selected as potential candidates for inclusion in the HHE, and additional information on these five locations was obtained. The information included data on demographics, absenteeism, union grievances, and workers' compensation. Using this information, NIOSH investigators chose two facilities to assess the nature and distribution of employee symptoms. One facility, in Boston, Massachusetts, had adjustable furniture at the work- stations; the other facility in Fort Lauderdale, Florida, did not. The investigation was conducted at the Fort Lauderdale TSC in Florida February 24 and 25, 1993, and at the Boston TSC in Massachusetts May 10 - May 12, 1993. An interim report was distributed to the NCSSAFOL and SSA in June 1993, describing the results from the ergonomic evaluations of (1) the Federal Prisons Industries Systems furniture which SSA had stated they planned on installing nationwide; and, (2) the reports provided by ergonomics consultants hired by management and the NCSSAFOL.

BACKGROUND

In the past ten years in the United States, there has been a marked increase in reports of work-related disorders of the neck and upper extremities. The U.S. Bureau of Labor Statistics' Annual Survey of Occupational Injuries and Illnesses[1] reported that in 1991 over 60% of all occupational illnesses were due to repetitive trauma disorders. This is an eight-fold increase during the preceding five years. Surveillance data, such as worker's compensation records,[2,3] have demonstrated similar increases in work-related musculoskeletal disorders. Several studies suggest that video display terminal (VDT) operators may be strongly represented in this trend.[4,5,6]

Work Force and Work Process

The SSA implemented nationwide toll- free telephone service for the general public in October 1988. Significant staff resources were shifted to this new service, while the overall agency workforce was reduced. Four mega-centers and 37 mini-teleservice centers were opened.

The TSC's employ approximately 4000 people, 3200 of whom are teleservice representatives. Teleservice representatives perform computer searches which involve toggling between screens to assess and enter information. Manual searches of a guidebook are required at times to answer customers' questions. Because the customers' requests can require a broad range of information, supervisors and co-workers are often asked for assistance on a single call.

The telephone lines are staffed from 7 a.m. to 7 p.m. During off-hours, callers may leave a recorded message. A computer automatically routes incoming calls to the next available representative. Representatives typically have less than one second between calls. During the day, a computer monitors the number and the length of calls taken by the representatives. Calls are also monitored by a supervisor for accuracy of information provided to customers. The job requires sitting for eight or nine hours a day at a workstation.

METHODS: QUESTIONNAIRE

Data Collection

A cross-sectional survey was used to assess back, neck and upper extremity musculoskeletal disorders, indicators of job stress, and their risk factors among TSC personnel. The study population consisted of 114 teleservice representatives drawn from the 153 employees in the two TSC's. Supervisors and managers (20), persons employed as teleservice representatives less than one year (18), and women who were currently pregnant (1) were excluded.

The management at the two TSC's provided NIOSH investigators with employee rosters which contained the name and current job title of each employee at the two centers. All employees present on the days of the investigation were notified of the HHE during an introductory meeting held by the NIOSH investigators and were asked to participate.

A self-administered questionnaire was used to obtain information on upper extremity and back musculoskeletal symptoms, job tasks, work history, and the work environment. The musculoskeletal questionnaire items were derived primarily from those used in previous NIOSH investigations of upper extremity WMD's,[7,8,9,10] with modifications made for the particular worksites and tasks in this evaluation.

The self-administered questionnaire was distributed to employees in groups ranging in size from 15 to 25. NIOSH personnel were present to answer the participants' questions as well as review the questionnaires for completeness when they were returned.

For each of the body areas (neck, shoulder, elbow, hand-wrist, back), a WMD was considered present if any symptoms (pain, numbness, tingling, aching, stiffness, or burning) in the affected part occurred within the preceding year and all of the following applied: (1) There was no preceding acute, non-occupational injury (such as dislocation, fracture, or tendon tear); (2) Symptoms began after starting the current job; (3) Symptoms lasted for more than one week or occurred at least once a month within the past year; (4) Symptoms were reported as "moderate" (the midpoint) or worse on a five-point intensity scale. We did not exclude as having a WMD a participant with a work-related injury if all other criteria were met. The case definition has been used in other NIOSH WMD studies.[7,8,9,10,11]

Questions addressing job stress were taken from a separate NIOSH general job stress instrument which has had extensive use in occupational stress research.[12] These questions consisted of multi-item scales related to job dissatisfaction, job demands, workload demands, job control, worker isolation, job security, hostility from clients, inter- and intra-group conflict, electronic monitoring, and social support from immediate supervisor and co-workers.

Statistical Analysis

Multiple logistic regression models were built to identify risk factors for the five WMD's: neck, shoulder, elbow, hand-wrist, and back. This technique calculates the odds ratio as a measure of association between predictor variables and outcome variables. The odds ratio above 1.0 indicates an association between the risk factor (predictor, or independent variable) and the WMD (outcome variable). (In this study, the WMD's were considered outcome variables, although in a cross-sectional study, it is not always possible to differentiate a predictor variable from an outcome variable.) The 95% confidence intervals (CI) indicates the probable range within which the odds ratio actually falls. Ordinarily, if the 96% CI includes 1.0, the apparent association between the risk factor and the WMD had a probability of more than 5% of occurring by chance alone and is not considered significant. A model was built for each of these five WMD's using 14 independent (predictor) variables that were considered important. These variables were location of the teleservice center, sex, age, seniority on the current job, hours spent typing at the VDT workstation, number of hours spent on the telephone, three separate variables related to chairs (chair discomfort, length of time sitting continuously in the chair, and perceived adequacy of adjustment of chair), perceived adequacy of adjustment of desk, perceived adequacy of adjustment of keyboard, perceived adequacy of adjustment of VDT, job control, and perceived workload variability (continually changing workload during the day). Variables were screened to identify potential predictors and develop a final model containing only independent variables significant at a p-value < 0.05. Sex was included in each model regardless of its statistical significance. All possible two-way interactions were examined.

Linear regression analyses were used to determine predictors of exhaustion (mental and physical) and job dissatisfaction. In these analyses, regression coefficients reflect the strength of the relationship between the independent and dependent variables. A regression coefficient greater than one indicates a positive relationship; a regression coefficient less than one indicates a negative relationship. The independent variables related to job demands, workload demands, job control, worker isolation, job security, participation in decision making, and social support from immediate supervisor and co-workers, in addition to the 14 independent variables used for the multiple logistic regression models of WMD's. All models controlled for sex. The final models contained only independent variables significant at a p-value < 0.05.

METHODS: ERGONOMIC EVALUATION

An ergonomic evaluation of representative workstations was performed at both teleservice centers. Workstation dimensions were measured, and the measurements were compared with recommended workstation dimensions.[13,14] The workstations were also evaluated with regard to placement of equipment and work materials; the VDT's and chairs were evaluated with regard to adjustments and compliance with recommended features/ properties and adjustments, such as screen height, screen character definition, chair adjustability, etc. Working postures were observed, and problematic postures related to furniture/equipment features or adjustments were noted. Aspects of the physical environment (e.g., lighting/glare) were also evaluated.

RESULTS

Participants

Of the 114 eligible teleservice representatives, all 108 at work on the days of our investigation completed the questionnaire; they included 31(91%) of the 34 in Boston and 77 (96%) of the 80 in Fort Lauderdale. The mean age of the study participants was 42 years (range: 23-64 years); 64% were female. The mean seniority on the current job was 4.7 years (range 1-21 years). The Fort Lauderdale TSC had a higher percentage of women, and its employees had longer tenure than the Boston TSC [Table 1].

Table 1
Demographics by Teleservice Center

	Boston	Fort Lauderdale	Overall
Mean age (in years)	42	42	42
Percent female	42%	73%	64%
Mean years working at TSC	3.3	5.2	4.7

WMD's

Prevalence

Seventy-three (68%) of the 108 participants reported symptoms that met the case definition for a neck, shoulder, elbow, hand-wrist, or back WMD. Of these, 37% had daily pain, 51% had seen a health-care provider, 38% had missed at least one day of work because of the disorder, and 1% had been assigned temporarily to a different job. In addition to the 73 WMD cases, 27 participants reported some musculoskeletal symptoms in the previous year that did not meet our definition of a WMD.

The total (both facilities) prevalence of WMD's was: neck-44%, shoulder-35%, elbow-20%, hand-wrist-30%, and back-33%.

The prevalence of any WMD (neck, shoulder, elbow, hand-wrist, back) was higher in the Fort Lauderdale TSC (60/77, 78%) than in the Boston TSC (13/31,42%). Participants in the Fort Lauderdale TSC had a higher prevalence of each of the WMD's, than those in the Boston TSC [Figure 1]. Prevalence rates in Boston ranged from 13% (shoulder) to 23% (neck, back) and in Fort Lauderdale ranged from 38% (back) to 53% (neck).

TABLE 1

Multiple logistic regression was used to determine if working in a particular center was associated with WMD's. Since the sex distribution between the two centers was not comparable, sex was controlled in these analyses. Center location was found to be associated with neck WMD (OR=3.5) and shoulder WMD (OR=4.0). The apparent associations between location and hand-wrist WMD (OR=2.2) and back WMD (OR=1.7) were not statistically significant [Table 2].

Table 2
Risk of WMD'S Associated with TSC Location

WMD	Odds Ratio*	95% CI
Neck	3.5	1.3- 9.2
Shoulder	4.0	1.2-13.1
Hand-wrist	2.2	0.7- 6.5
Back	1.7	0.6- 4.7
Elbow	0.8	0.3- 2.4

adjusted for sex (see text)

Ergonomic evaluation

See Appendix A for detailed ergonomic assessments of both TSC's. A summary of major findings is given below.

The ergonomic evaluation revealed a disparity in ergonomic conditions between the two centers. The Fort Lauderdale TSC had non-adjustable workstations with limited space for equipment and work materials. The arrangement of the VDT screens was generally non-optimal (i.e., screens were too close to the user and placed above eye level), the workstation surface was too high to serve as a keyboard support, and many of the chairs were nonadjustable, with operator-supplied pillows and cushions serving as lumbar supports. The nonadjustable furniture universally promoted undesirable postures (i.e., elevated arms, hunched shoulders) that have been associated with neck and shoulder discomfort/disorders in other studies[13], and the lack of lumbar support and adjustability of many of the chairs had the potential to promote back discomfort.

Although there were some problems with the workstations and chairs at the Boston TSC, in general, the ergonomic conditions were superior to those at the Fort Lauderdale TSC. The furniture was adjustable, with separate support surfaces for the VDT and the keyboard, the majority of the chairs had recommended adjustable features,[13,14] and there was ample room for the VDT equipment and work materials. At the Boston TSC, suboptimal postures were related to non-optimal arrangements of the VDT equipment, but the prevalence of these postures was lower than at the Fort Lauderdale TSC.

Predictors for WMD's

Of the 14 independent variables, the following variables were found to be significantly ($p \leq 0.05$) associated with WMD's in the final regression models:

a. The odds of having **neck WMD's** were increased for those reporting:
(1) chair discomfort (OR=3.5; 95% CI 1.4-8.9), and (2) workload variability (continually changing workload during the day) (OR=1.2; 95% CI 1.0-1.4).

b. The odds of **shoulder WMD's** were increased for those reporting:
(1) non-optimally adjusted desk height (OR=5.1; 95% CI 1.7-15.5), (2) Fort Lauderdale location (OR=4.0; 95% CI 1.1-14.6), and (3) non-optimally adjusted VDT screen (OR=3.9; 95% CI 1.4-11.5).

c. The odds of having **elbow WMD's** were increased for those reporting a non-optimally adjusted chair (OR=4.0; 95% CI 1.2-13.1).

d. The odds of having **hand-wrist WMD's** were only increased for those reporting to use the telephone more than eight hours per day (OR=4.7; 95% CI 1.3-17.4). Since telephone headsets were used continuously by all TSC representatives, the number of telephone hours in all likelihood reflects total work hours involving all aspects of the job.

e. The odds of having **back WMD's** was increased for those reporting a non-optimally adjusted chair (OR=4.6; 95% CI 1.7-12.5), and inversely associated with perceived job control (OR=0.6; 95% CI 0.5-0.7).

Job stress Variables

Prevalence

In response to the question, "How satisfied are you with your job?" 58% of the teleservice representatives reported that they were "not too satisfied" or "not at all satisfied." Seventy-five percent reported that they were "often" or "very often" physically exhausted at the end of the workday, and 92% reported being "often" or "very often" mentally exhausted at the end of the workday.

The teleservice representatives perceived that they had very little control over what was done by others, had little participation in decision-making or in planning regarding their own jobs, and had little freedom to regulate their own activities. They perceived their workload as heavy, their workload variability as high, and their future as only somewhat certain. Representatives often perceived a constant pressure to keep working, considered the supervision as moderate, and had little conflict with their co-workers. Ninety-six percent reported that they faced hostility or abuse from customers or clients.

Teleservice representatives generally reported that electronic monitoring did not improve performance, did not help employees in correcting their errors, and did not often motivate them to work faster or better. Representatives often felt watched by the monitoring system, thought that the system made them speak less to fellow workers, and thought that it had a negative influence on socialization at work. Finally, the representatives reported that electronic monitoring never made them skip breaks or work later.

The Fort Lauderdale participants perceived less control over the policies made at the TSC ($p<.01$) and perceived more physical and mental exhaust ($p<.01$), than the Boston teleservice representatives. None of the other job stress scales (including dissatisfaction) differed significantly by center.

Predictors for exhaustion and job dissatisfaction

After controlling for sex, **physical and mental exhaustion** was found to be increased for those reporting: (1) workload variability (continually changing workload during the day) ($p \leq 0.01$), (2) lack of influence and control in policies ($p \leq 0.01$), and (3) lack of future certainty ($p \leq 0.01$) [Table 3].

Table 3
Significant Work-Related Predictors of
Physical and Mental Exhaustion

Variables for physical and mental exhaustion	Regression coefficient*	Standard error	(p value)
Perceived workload variability	0.19	0.04	($p \leq 0.0001$)
Perceived control in policies	-0.11	0.03	($p \leq 0.0012$)
Perceived future certainty	-0.07	0.02	($p \leq 0.0052$)

adjusted for sex (see text)

Job dissatisfaction was increased for those reporting: (1) lack of future certainty ($p \leq 0.01$), (2) non-optimally adjusted keyboard ($p \leq 0.01$), (3) poor supervision ($p<0.01$), and (4) non-optimally adjusted VDT screen ($p \leq 0.05$) [Table 4].

Table 4
Significant Work-Related Predictors of
Job dissatisfaction

Predictors	Regression coefficient*	Standard error	(p.value)
Perceived future certainty*	-0.28	0.05	($p \leq 0.0001$)
Perceived non-optimally adjusted keyboard	1.87	0.61	($p \leq 0.0027$)
Perceived poor supervision	0.28	0.09	($p \leq 0.0029$)
Perceived non-optimally adjusted VDT screen	1.22	0.56	($p \leq 0.0306$)

*
adjusted for sex (see text)

DISCUSSION AND CONCLUSIONS

The main objectives of the investigation were to determine the prevalences and risk factors for WMD's and job stress among TSC representatives working at two locations. symptoms of neck WMD's were most prevalent, followed by those of the shoulder, back, hand-wrist, and elbow. Employees in the Fort Lauderdale TSC had a higher prevalence of WMD's (78%), than those in the Boston TSC (42%).

Of the job task and work organization variables, the use of a telephone more than eight hours per day was significantly associated with hand-wrist WMD's. Because 99% of the teleservice representatives used telephone headsets, it is unlikely that it is use of the phone per se that affects the hand-wrist. Rather, telephone hours are most likely a surrogate for working hours. Survey participants were not asked how many hours they worked per day, but according to management, workdays ranged from 7 to 9 hours per day. This was consistent with information obtained on the hours spent on the telephone. We did not ask directly about work hours because we initially thought that all employees worked 8-hour days.

In contrast to some other studies, no association was found between hand-wrist WMD's and typing hours. This may be due to the intermittent nature of the typing tasks. Additionally, previous studies have reported conflicting results.[15,16,17,18] Controversy still remains as to whether a causal relationship exists between time spent typing on computer keyboards development of hand-wrist disorders.

Of the workstation equipment variables, a perceived non-optimally adjusted desk height and a perceived non-optimally adjusted VDT screen were significantly related to shoulder WMD's. Chair discomfort was a significant predictor of neck WMD's. Awkward postures promoted by the nonadjustable furniture at the Fort Lauderdale TSC are those shown by previous studies to be highly correlated with pain/discomfort in the neck and shoulder regions.[13]

Of the job stress variables, those employees who reported a perceived lack of control over their job tended to have a higher prevalence of back WMD's. Perceived workload variability was associated with

neck WMD's and with feeling exhausted at the end of the work day. The finding that psychosocial job stressors were associated with musculoskeletal symptoms in the present study should not be interpreted to mean that these symptoms are not real, or merely a psychological construction. The causal linkages between a demanding psychosocial environment at work and symptoms of WMD's are not well understood, but several plausible mechanisms can be postulated. Psychosocial stressors resulting in psychological stress may increase awareness of musculoskeletal symptoms or may affect perceptions of their cause. Alternatively, musculoskeletal symptoms related to physical ergonomic stressors could contribute to psychological stress.

The study design used in this evaluation has a number of strengths and weaknesses. This is a cross-sectional study, which measures health outcomes and exposures at a single point in time. Because risk factors and health problems are measured at the same time, it is not always possible to determine which occurred first. For example, an important association was found between back symptoms and perceived non-optimally adjusted chairs, but with this study design we can't ascertain whether symptoms were the result of perceived non-optimally adjusted chairs or visa versa.

Although there was little potential for selection bias occurring among the study participants because of the high response rate (95%), inherent in this type of study is the potential for "survivor bias" that is, not including people who left their jobs because of the health problems of interest. This may result in an underestimation of the prevalence of the health problems. However, survivor bias was not considered to be a major problem in this study, as both records and accounts of TSC employees indicate that the number of individuals who left the workforce during the previous year was small, and because of the substantial prevalence of WMD's among the current workforce.

The WMD prevalence rates were determined in this study solely by self-reported symptoms from questionnaires. This may have led to disease misclassification and therefore to overestimation or underestimation of the prevalence of WMD's. Moreover, those who reported symptoms may have been more aware of, and thus may have tended to over-report, job-related stressors. For example, those who experience WMD's may have been more aware of the sub-optimally positioning of workstation equipment, or lack of control over the job than those with no symptoms. If this occurred, associations between these factors and symptoms could be exaggerated.

This study did not address the impact of non-work-related variables and their possible associations with musculoskeletal disorders. For example, we did not address social support issues of spouses, friends, and relatives, nor did we cover issues such as child-care, home responsibilities, or recreational activities which may have some impact in the occurrence of back, neck, and upper extremity symptoms.

RECOMMENDATIONS

1. To prevent WMD's it is important to improve ergonomic conditions at workstations, control the workload variability, and limit overtime work-hours.

2. The development of ergonomics programs at the TSCs should continue. We recommend that top management commitment and employee participation be an important part of the ergonomics program. A joint employee-management Ergonomics Committee, with representation from all teleservice centers, should be created, appropriately supported with resources, and convened on a regular basis. The responsibility of the committee should include involvement in decisions on appropriate interventions affecting employees at risk for WMD's.

3. The TSC should provide specific training for the ergonomics department employees in health and ergonomic hazards surveillance, and in workstation and job evaluation techniques.

4. The SSA should consider repeating a symptom survey one year after the furniture is updated at the Fort Lauderdale TSC to estimate the change in prevalence of WMD's.

5. The SSA should continue updating and purchasing adjustable workstation equipment for each employee. Our observations indicated that the Boston TSC had adopted adjustable furniture to accommodate individual differences and that most renovated workstations were of reasonable ergonomic quality. However, the Fort Lauderdale TSC lacked this equipment. The SSA should evaluate how the equipment is being used and obtain employee feedback (in a systematic manner) on advantages and disadvantages of equipment. Suggested adjustment ranges for this equipment can be found elsewhere.[19]

6. The Boston TSC employees have undergone training on the use of adjustable VDT workstation equipment and found the information to be useful. Periodic instruction on the use of adjustable workstations, chairs, and equipment to optimum ergonomic advantage should be considered to remind workers the likely benefits of adjusting workstations.

7. Prompt evaluation of musculoskeletal symptoms by a health care provider should be available to employees without fear of supervisor or employer reprisal. Guidelines for health care providers to evaluate and treat these disorders have been published elsewhere.

8. To reduce perceived exhaustion and job dissatisfaction, efforts should be directed at reducing uncertainty about the future. Employees should be kept informed of conditions and events that impact upon their employment status. Efforts to provide employees more control over policies and procedures regarding work activity should also prove helpful in reducing perceived exhaustion and job dissatisfaction.

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1. The National Council of Social Security Administration Field Operations Locals of the American Federation of Government Employees, Chicago, Illinois
2. Management Social Security Administration Teleservice Centers, Baltimore, Maryland
3. OSHA Region I, III, and IV

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Mention of brand names in the report does not constitute endorsement by NIOSH.

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APPENDIX A: Ergonomic Evaluation

The evaluation consisted of an assessment of the workstation/furniture ergonomics, observations of teleoperator postures while working, and an assessment of lighting and glare at the two worksites. Following is a description and ergonomic assessment of the workstations/furniture and relevant physical environment factors (e.g., lighting, noise) at each worksite.

Fort Lauderdale

All teleoperators at this worksite had identical workstations and VDT's, although chairs and accessories varied somewhat between workstations. The workstations consisted of desks, with non-adjustable worksurfaces, with three drawers on the left for supplies, a center drawer, and a file drawer and supply drawer to the right. The worksurface dimensions were 30 X 59.5" (76 X 151 cm), and the worksurface top was 29.5 inches (75 cm) from the floor. The leg space under the desk was 26.5 inches (67 cm) high and 28 inches (71 cm) wide. The leg space was adequate, with dimensions greater than the minimum recommended dimensions (20" X 20"; 51 cm X 51 cm; ANSI, 1988). Although the worksurface served as a keyboard support, it was higher than recommended values (23-28"; 58.5-71 cm). Operators had to elevate their arms and shoulders in order to use the keyboards. These postures have been found to be highly related to neck and shoulder pain/disorders (Grandjean, 1987).

Workstations

In general, space was very limited at this site. Teleoperators had very little room for equipment and working materials on their desks. VDT's, keyboards, teleservice center operating guides, phones, rubber stamps, notepads, etc. were crowded onto the worksurfaces. It was observed that employees often pulled out the top drawers on either side of their desks in order to expand the size of their worksurfaces, and that each employee's in/out box was placed on top of their VDT screen. Personal belongings were stored under the desk, and several employees had footrests and foot stools as well, resulting in limited leg room.

Most VDT screens were situated in front of the operators approximately 17" (43 cm) from the operator's eyes. This placement is closer than the distance preferred by most VDT users (i.e., 23-36"; 59-93 cm). Presumably to address this problem, a few operators placed the VDT screen to one side of the desk, and placed keyboards diagonally across the work surface along the other side of the desk. This, however, resulted in a posture where they sat somewhat parallel to the desk front and twisted their trunk in order to type. Such postures, if prolonged, can result in back and shoulder discomfort. Some employees positioned their screens to one side of their desks and their keyboards in front, turning their heads for prolonged periods of time to view the screen. Such postures can produce neck and shoulder discomfort.

VDT's

The VDT screens had tilt and swivel adjustments, but were not height adjustable. Employees used telephone books, or stacks of paper to adjust the height, an adjustment which is potentially unstable. Many of the screens were not placed at the recommended height (i.e., with the top of the screen at, or slightly below, the horizontal line of sight). Instead, many screens were adjusted so that the line of sight was at the center of the screen or below. This resulted in operators tilting their heads back slightly to

look up at the screen. Additionally, some screens were tilted upward which facilitated glare and reflections from the overhead lighting.

The display quality was good; no flicker, character blurring, or character distortion around the edges of the screens was observed. However, some of the critical client information was presented in red or royal blue characters on a black background. Neither of these colors contrasts highly with the black background, and should be avoided. It was noted that operators often leaned forward, or traced information on the screen with their finger, when it was printed in blue letters on a black background. Such postures, if frequent or prolonged, can result in back, shoulder and/or neck discomfort.

Chairs

There were a large variety of chairs at this worksite. Approximately half of the chairs were nonadjustable styles, and the remainder had some degree of adjustability. The newest style of chair had height adjustable seats and backrests. Some of these chairs had armrests, which were constructed of a hard plastic, and which were non-adjustable. A number of the employees reported that these chairs (particularly the backrests) were uncomfortable. Some reported that they had no training in how to use the adjustments, or how to determine what adjustments would be optimal for them. The non-adjustable chairs had no lumbar support, and often had chair pads, cushions, pillows, or back support devices placed against the backrest to provide support for the lower back. Sitting for long periods of time in chairs with inadequate back support can result in back discomfort.

Lighting/glare

This office was located in a long narrow room with rows of fluorescent lamps along the length of the room. A bank of windows covered one end of the room, and part of the other. The fluorescent lamps had roughened plastic covers, which can promote light scatter and glare. Although the lights were not in the line of sight, they were located in front of, behind, or directly over the workstations, and glare and reflections on the screens from the lights were problematic. Five operators had mesh or glass glare screens on their VDT's. The mesh screens appeared to reduce the contrast of the screen substantially (especially the greens and blues).

Environment

Noise from operator conversations with clients, and from unshielded printers along the sides of the room, was problematic in that it interfered with operator/client interactions. Noise covers for the printers would have been helpful in reducing noise levels. The operators also reported problems with the air conditioning. It was reported that the room temperature fluctuated, and that sometimes it was "freezing" in the room. Additionally, paper or cardboard had been taped over a number of the air vents in an attempt to regulate the airflow.

Boston

The Boston facility was equipped with adjustable Federal Prison Industries (FPI) Systems furniture. The FPI workstations had panel-hung worksurfaces in a L-shaped configuration. The workstations were

generally grouped in sets of four, with two "right-handed" (i.e., non-VDT worksurface on the right) and two "left-handed" (i.e., non-VDT worksurface on the left) workstations in each grouping. Each workstation had a 41.5" (105 cm) X 24" (61 cm) worksurface with a slide-out/articulating keyboard tray attached to the underside, and a 71.5" (182 cm) X 30" (76 cm) worksurface. Each workstation also had two rolling pedestal-type file cabinets which fit underneath the worksurfaces. Panels 42" (107 cm) high were placed along the rear and side of the worksurface with the attached keyboard tray, and 66.5" (169 cm) high panels were placed along the rear of the adjoining worksurface. Overhead shelves were attached to the taller panel, and fluorescent task lamps were mounted on the underside of the shelves. Although there were a variety of chairs in use at the worksite, most employees were using a recent version of the FPI chair (see description below). In general, the ergonomic conditions at the Boston facility were superior to those at the Fort Lauderdale facility. However, some problems were observed, and are noted below.

A. <u>Workstations</u>

1. **Adjustability:** The worksurfaces could be height adjusted in one-inch increments. However, the adjustments were inconvenient in that they required special tools and more than one person to implement.

2. **VDT support surface:** The 24" (61 cm) deep worksurface was obviously designated as the support surface for the video display terminal (VDT), since a keyboard tray was attached to the undersurface. However, this worksurface was not deep enough to allow adjustment of the monitor to a distance preferred by most VDT users (i.e., a screen distance of 17-38" (44-96 cm) from the table edge). Consequently, few workers had their VDT screens "properly" positioned in front of the keyboard tray. Most frequently, the screen was placed in the rear of the workstation corner, which allowed the user to sit at a greater distance from the screen. In addition, "proper" placement of the monitor and keyboard in the area allotted for them forced the user to place most of their work materials to one side of the monitor (i.e., to the left for "left-handed" workstations and to the right for "right-handed" workstations). This created the opportunity for awkward, twisted postures while writing or viewing reference materials. Corner placement of the keyboard allowed operators to arrange work materials within easy reach on either side of the VDT. However, this arrangement also created problems. The worksurfaces were too high for keyboard placement, and individuals who placed their keyboards on these surfaces often sat with hunched shoulders and abducted elbows (i.e., elbows held away from the body) while keying.

   A number of operators placed frequently accessed reference materials in front of their keyboards instead of the screen, and placed the screen to the side. If the reference materials are referred to more frequently than the screen, this arrangement may be the preferred one. However, if both screen and reference materials are accessed equally often, an arrangement that discourages frequent twisting of the neck or trunk between the two is needed.

   Finally, the worksurfaces had sharp, rather than rounded, edges. This created an opportunity for skin irritation of the palms, wrists or forearms when they were rested against the edge (e.g., while typing). In addition, where operators rest their wrists against the edge of the worksurface, there may be the potential for compression of the ulnar nerve.

3. **Keyboard tray:** The keyboard trays could be pulled out approximately 11" (28 cm) from the worksurface, and their height could be adjusted between approximately 4.5" (11 cm) below the surface height to approximately .5" (1.3 cm) above the worksurface height. Given that many of the worksurfaces were 29-30" (73.7-76 cm) high, the keyboard tray had the potential to be adjusted to a height outside of the recommended range (23-28"; 58.5-71 cm). In addition, the tray was placed too close to the adjoining worksurface, and there was no room for body movement to that side. The keyboard tray did not slide back under the worksurface far enough when not in use, and in some cases, protruded beyond the worksurface edge when fully retracted. The keyboard tray reduced leg room, and some operators twisted their lower extremities to the side while typing so that they could cross their legs or assume alternate leg postures. Finally, as with the worksurfaces, the keyboard trays had sharp, rather than rounded edges.

4. **Shelf units:** The shelf units were attached to the 66.5" (169 cm) panels, and provided overhead storage above the 71.5" (182 cm) long worksurface. Teleservice operators appeared to use the shelves most frequently for correspondence materials and reference books. Many operators did not stand up to access these materials, but rather reached for the materials from a seated position. The latter involves excessive reaches and awkward postures. If done frequently, this creates the potential for shoulder and back discomfort.

   The shelf units had task lights mounted underneath. The task lights were attached to metal strips and could slide to the front or back of the shelf unit. However, the lights did not slide readily on these strips, and the strips could easily become detached from the underside of the units when the task light was adjusted. When the task light was brought forward to the front edge of the shelf unit, there was the potential for the task lights to be in the line of sight, particularly if the VDT was placed in the corner or under the lights. Additionally, the task lights created glare on screens positioned in front of the keyboard trays.

5. **File cabinets**: The vertical edges of the pedestal file cabinets were sharp, rather than rounded. In addition, the cabinets extended several inches beyond the front edge of the 24" worksurface when placed below this worksurface. This created a potential hazard as operators could hit their knees/legs against the cabinet as they moved around.

6. **VDT screens:** The VDT screens were not height adjustable. Operators used stacks of paper to raise their terminals to the preferred height. This arrangement is unstable. A height adjustable terminal platform should be supplied to operators.

B. <u>FPI Chair</u>

The majority of operators at the Boston facility had been provided with a recent version of the FPI chair. The chair had a full backrest, armrests, and the following adjustments: Seat pan height and tilt, and backrest height. Additionally, the chair could be adjusted to freely move (i.e., "float" or rock) within a selected range. Following are observations regarding this chair.

1. **Adjustments:** The chair was missing a backrest angle (i.e., "tension") adjustment. Thus individuals could not change the backrest angle to support their back when they assumed different trunk postures (i.e., erect to backward inclined postures).

The seat height adjustment was jerky rather than smooth in action. Some adjustments did not work well, or were stiff in action. For example, after attempting the seat pan tilt adjustment, a NIOSH researcher had to stand up and push on the seat pan while holding the adjustment lever to get the seat to return to horizontal.

The backrest height adjustment lever was located under the backrest. It was stiff in action, and one's fingers were easily pinched when using it.

The armrests were nonadjustable, and composed of hard plastic. They were approximately 3" (7.6 cm) wide and 8" (20 cm) long, and located 7.5" (19 cm) above the seat surface. The armrests appeared to be too high for many individuals. Operators either did not use the armrests, or hunched their shoulders and abducted their elbows in order to raise their forearms up to the rests. These postures can cause neck and shoulder discomfort.

Several of the operators had received no training in how to adjust the chairs and their chairs were not adjusted optimally.

2. **Chair size:** The chairs were too large for smaller individuals. The seatpan was approximately 19.5" (49.5 cm) deep and 20.5" (52 cm) wide. Recommended seatpan dimensions for accommodating the majority of users (i.e., 95th percentile female and larger) are 15-17" (38-43 cm) deep by 16-18" (40-45 cm) wide.

C. Lighting/glare

Lighting and glare were problematic at this teleservice center. The center had banks of floor-to-ceiling windows along the outer walls. The windows served as a source of direct glare for operators who faced the windows, and served as a source of glare and reflections on the VDT screens of operators seated next to, or with their backs to the windows. Although vertical blinds were provided for these windows, few were in use.