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An Investigation of Health Complaints and Job Stress in Video Display Operations

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A questionnaire survey dealing with working conditions, job stress factors, health complaints, and psychological mood state was filled out by approximately 250 video display terminal (VDT) operators and 150 nonoperator control subjects at five participating work sites. Clerical VDT operators reported higher levels of job stress and health complaints but little difference in psychological mood state than did professional VDT operators and the control subjects. The job stressors showing the greatest impact on the clerical operators dealt with workload, workspace, lack of control over job activities, boredom, and concerns about career development. The health complaints that showed the greatest differences between the groups dealt with visual, musculoskeletal, and emotional health problems. The results indicate that job content factors and VDT use interact to contribute to VDT operator problems.

INTRODUCTION

Most of the research dealing with the health impact of video display terminals (VDTs) has been conducted in Europe. A review of the various studies and evaluations of VDTs indicates much interest in ergonomic factors, particularly those that might contribute to visual problems of operators. This is likely due to the high frequency of VDT operator visual complaints which is generally reported (Grandjean, 1979). Lesser attention has been directed at psychological job stress in these operations and how much stress relates to worker health complaints. In one study, Gunnarsson and Östberg (1977) queried VDT operators about stressful ele-

ments on their jobs. In a department where operators had little control over their job tasks, 72% complained of monotony, while in a department where the job afforded some variety and control, only 10% felt the work was monotonous. In terms of workspace, about one-third of all the operators felt that the pace was too fast, while one-third felt that the pace was too slow. When asked if their job was stressful, 64% said yes. In the group with little control of job task, 72% indicated that they would prefer a different job assignment. The results of this study are difficult to interpret since there was not an adequate control group. As such, it is not possible to determine whether it was VDT use per se or other factors which were responsible for the operator complaints.

Grandjean (1979) cites a study by Cakir, Reuter, von Schmude, and Armbruster (1978) which found that feelings of stress as ex-

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pressed by a group of VDT operators did not differ in magnitude from those expressed by worker groups examined in previous studies. However, VDT users displayed some loss in motivation and gave lower estimates of performance level.

In 1979, Cakir, Hart, and Stewart reported a series of studies aimed at defining the psychological and physical consequences of VDT work situations. In one study, VDT operators under a piece-rate pay system were compared to a group of hourly paid operators. The results indicated differences between the groups in sociability, frame of mind, state of stress, fatigue, and inner security with the piece-rate operators scoring more poorly in all categories. After work both groups showed significantly higher levels of stress and sleepiness and lower levels of well-being, positive frame of mind, self-confidence, social awareness, sociability, and willingness to undertake further activity than they did before work.

A second study in this series, involving more than 1000 VDT operators, examined the relationship between self-reported monotony and fatigue. The results indicated that 20 to 30% of typists engaged in data input work with VDTs and 10% of other categories of clerical workers complained of monotony. On the other hand, for VDT operators who previously did clerical work, 60% complained of monotony even though their present jobs were similar to their previous clerical jobs in task requirements. The study showed that the jobs reporting the highest levels of monotony also reported the highest levels of fatigue.

Over the past few years, complaints about VDTs have been increasing steadily in the United States. Early efforts by NIOSH in this area dealt with evaluating the possible health risks of VDTs regarding ionizing and nonionizing radiation emissions. Some attention was also given to human factors concerns, but it remained for the current investi-

gation to offer the first comprehensive evaluation of the problem in the United States. This paper deals with findings on job stress and strain and on health complaints.

METHODS

A specially prepared questionnaire was used to gather information about job demands, job stressors, job stress level, psychological mood, health complaints, and working conditions for VDT operators and control groups at each of the five workplaces included in this investigation. Various measures of job demands and job stress were contained in the questionnaire. These included scales developed to compare stress in various jobs (Caplan, Cobb, French, Van Harrison, and Pinneau, 1975), standardized job stress scales (Insel and Moos, 1974), and selected questions on sources of job stress developed specifically for this investigation. The frequency of health complaints experienced in the last 1-yr period was recorded for each of 59 separate health problems using a four-point scale ranging from never to constantly. The presence of a diagnosed disease state within the previous 5 yr for each of 23 diseases was also recorded by participants. Psychological mood state was evaluated using a standardized psychological test (McNair, Lorr, and Droppleman, 1971). Included in the questionnaire form was a cover letter that explained the purpose of the investigation and gave instructions for filling out and returning the survey form. Table 1 lists the various subject areas that were examined by the questionnaire.

Workplaces

The investigation was carried out at five workplaces—four newspapers or related operations and one insurance company. The VDT operators at these workplaces engaged in various jobs including data entry and retrieval, word processing, writing, editing, and

TABLE 1

Topic Areas Covered in Questionnaire

<i>Topic Area</i>	<i>Example</i>
Job information	Job titles, work tasks, type of equipment used, work schedule, work/rest breaks
Job satisfaction	Satisfaction with workload, pace, job tasks
Job stress	Work pace, workload, ambiguity, attention required, skill use
Job future	Career growth, usefulness of skills, promotion possibilities, layoff, replacement by machines
Work environment	Noise, temperature, lighting, distractions
Social environment	Capabilities, adequacy, problems
Demographic	Age, sex, ethnic background, height, weight, marital status
Supervision	Style interaction
VDT-specific areas	Features, use, problems
Medication usage	Type, manner
Health complaints	General health problems, visual complaints
Medical history	Major diseases
Sleep patterns	Amount, quality
Personal habits	Alcohol usage, smoking, coffee, tea, soft drink consumption
Recent life events	Holmes-Rahe Scale
Mood states	Anxiety-tension, depression-dejection, anger, vigor, fatigue, confusion

telephone sales. The control subjects at these workplaces were engaged in data entry and retrieval, word processing, and telephone sales, but did not use VDT equipment in carrying out their work activities. For example, the control subjects doing word processing tasks were using standard electric typewriters, while those doing data retrieval tasks were using card index equipment.

Distribution and Collection of Questionnaires

Since the parties requesting the investigation served as the target group for study, traditional sampling strategies and distribution methods were not employed. Distribution and collection of the forms were planned to minimize disruption of ongoing work activities and differed for each workplace. Generally, on the morning of the investigation, the supervisors of each department at a workplace made an announcement explaining the investigation. Later, NIOSH researchers explained the investigation and distributed forms. Wherever possible, the NIOSH

investigators met with the employees in small groups to explain the purpose of the survey, answer employee questions, and distribute the questionnaire. At some sites there were no central facilities for gathering employees. In these cases, forms were handed out to each employee individually with a short explanation. Each was referred to the instructions in the cover letter of the form. The forms were filled out at home. The NIOSH investigators were on site the next day to collect completed forms and answer questions. A postage-paid envelope was provided with all forms for those employees completing the questionnaire but not wishing to return it to work.

Subject Population

The data from the five workplaces were pooled to achieve an adequate sample size for statistical evaluation. The fact that all five worksites had similar video environments and were located in the same geographic (city) area offered further rationale for this com-

binning procedure. The respondents to the questionnaire survey were put into three groups based on their work activities. These were: (1) professionals using VDTs, (2) clerical and office workers using VDTs, and (3) non-VDT users (who served as control subjects). The professionals who used VDTs were mainly reporters, editors, copy editors, and printers. These jobs afforded a great deal of self-control over work activities which provided variety and challenge. These operators were not tied to their VDTs for any set time period and could set their own workspace within deadline limits. The clerical VDT operators were data entry clerks, data retrieval clerks, classified advertising clerks, circulation and distribution clerks, and telephone inquiry clerks. These jobs were highly regimented, with little operator control over work activity. The operators were tied to their workstations for fixed time periods except for formalized work/rest breaks and had little control over their workspace. The non-VDT users were in jobs identical to those of the clerical VDT operators, except that they did not use the VDT in performing their job tasks. Their working conditions were almost identical to those of the clerical VDT operators.

Statistical Analyses

The three groups were compared over various measures of job stress, health complaints, and psychological status. The job stress and psychological status measures were examined using an analysis of variance (General Linear Model Procedures for Unequal Cells, SAS, 1979) to compare the mean levels, while health complaints measures were examined by chi-square analysis to compare the percentages reporting a complaint. Duncan Range Tests were used to determine which particular means differed when an analysis of variance indicated significant differences.

To evaluate the similarity of makeup of the

VDT operator groups and control subjects, demographic variables such as age, sex, ethnic background, education level, and marital status were compared. The percentage of persons in various categories was analyzed using chi-square. When significant differences were observed for a particular demographic variable, a two-way analysis of variance with the total number of health complaints serving as the dependent variable, was used to determine if there was an interaction such that the demographic variable influenced any of the groups differently from the others. If a positive interaction was found, further analysis of the data was undertaken to isolate the nature of the interaction.

RESULTS

Demographics

The number of respondents to the questionnaire survey differed from group to group. The 508 VDT operators had a 50% response rate, while 38% of the 415 control subjects responded. Table 2 shows the distribution of respondents by age, sex, and ethnic background. Evaluations of the demographic variables for the professionals using VDTs, the clerical VDT operators, and the control subjects indicated significant differences in the percentages of respondents in the various categories for age, sex, ethnic background, level of schooling, marital status, years with current employer, and years at current job. Two-way analysis of variance tests indicated that there were no significant interactions for any of these demographic features using total health complaints as the dependent variable. Therefore, it was concluded that they did not differentially affect the study groups.

General Sources of Stress

Table 3 shows the percentages of VDT operators and control subjects reporting the frequent occurrence of eight sources of life

TABLE 2

Number of Study Participants by Select Demographic Characteristics*

	Professionals Using VDTs	Clerical VDT Operators	Control Clerical Group
White Females (Age, yr)			
<25	1	5	9
26-45	27	12	14
>45	6	6	19
White Males (Age, yr)			
<25	2	5	1
26-45	34	6	4
>45	47	1	6
Nonwhite Females (Age, yr)			
<25	0	2	3
26-45	3	31	20
>45	0	5	9
Nonwhite Males (Age, yr)			
<25	0	1	0
26-45	4	5	7
>45	1	3	1

* Includes only respondents who reported their ethnic background, sex, and age.

stress and personal problems. The chi-square homogeneity test showed significant effects due to job stress ($p < 0.05$) and career stress and health problems ($p < 0.01$). Significantly more clerical VDT operators reported job stress health problems than did professionals using VDTs or control subjects, while both clerical VDT operators and professionals using VDTs reported career problems more often than did control subjects.

Job Stress

Table 4 shows the response means for all VDT operators and for control subjects for the 10 dimensions of the Work Environment Scale (Insel and Moos, 1974). Comparing the experimental groups with scale norms reveals that all three reported less involvement, less cohesion, less staff support, less autonomy, less task orientation, greater work

TABLE 3

Percentage of VDT Operator and Control Subjects Reporting Frequent Sources of Life Stress and Personal Problems

	Job**	Career*	Finances	Other People	Health*	Time Pressures	Unknown	Family
Professional VDT	37	30	26	26	3	41	9	18
Clerical VDT	48	34	31	17	14	37	16	16
Control	29	15	26	14	5	31	10	16

* $p < 0.01$ using a chi-square test for homogeneity.** $p < 0.05$.

TABLE 4
Mean Responses for VDT Operators and Controls for WES' Stress Scales

	<i>Involvement**</i>	<i>Peer Cohesion*</i>	<i>Staff** Support</i>	<i>Autonomy*</i>	<i>Task Orientation</i>
Professional VDT (PV)	1.50	2.09	1.85	2.32	1.82
Clerical VDT (CV)	1.04	1.33	1.38	1.14	2.02
Control (C)	1.25	1.88	1.56	1.75	1.81
Duncan Range Results	PV > CV	PV&C > CV	PV > CV	PV > C > CV	
WES Norms ¹	2.80	2.73	2.94	2.69	2.51
	<i>Work* Pressure</i>	<i>Clarity</i>	<i>Supervisory Control*</i>	<i>Innovation</i>	<i>Physical Comfort</i>
Professional VDT (PV)	2.25	1.35	1.41	1.24	1.27
Clerical VDT (CV)	3.38	1.17	3.04	1.18	1.28
Control (C)	2.43	1.55	2.65	0.94	1.13
Duncan Range Results	CV > PV&C		CV > C&PV		
WES Norms ¹	1.77	2.33	2.32	2.40	2.04

* $p < 0.01$ using an analysis of variance.

** $p < 0.05$.

¹ Work Environment Scale (Insel and Moos, 1974) Form S.

pressure, less clarity, less innovation, and less physical comfort. In fact, the only group responding positively with respect to test norms were professional VDT operators who reported less supervisory control than the norm. This significantly negative bias is discussed later.

The analysis of variance revealed the following significant stress factors: involvement and staff support were significant at $p < 0.05$; peer cohesion, autonomy, work pressure, and supervisory control were significant at $p < 0.01$. Subsequent analysis using the Duncan Multiple Range Test showed the following: the clerical VDT operators reported significantly less peer cohesion and job autonomy, more work pressure, and greater control by their supervisor than professionals using

VDTs or control subjects. The clerical VDT operators also reported less involvement and staff support than the professionals using VDTs. The professionals who used VDTs reported greater autonomy and less control by their supervisors than the control subjects. For all of the significant stress factors there was a similar pattern of response in that the clerical VDT operators reported the highest levels of stress, followed by the control subjects, and then the professionals using VDTs, who showed the lowest levels of stress.

Table 5 shows the response means for the VDT operators and control subjects for nine job demand dimensions developed by The Institute for Social Research (ISR) (Quinn and Shepard, 1974; Caplan et al., 1975). Systematically "negative" responses, when com-

TABLE 5

Mean Responses for VDT Operators and Controls for Job Demands¹ Stress Scales

	<i>Workload* Dissatisfaction</i>	<i>Boredom*</i>	<i>Role** Ambiguity</i>	<i>Quantitative Workload*</i>	
Professional VDT (PV)	2.21	2.09	1.55	3.55	
Clerical VDT (CV)	3.17	3.36	1.79	4.04	
Control (C)	2.43	2.63	1.73	3.61	
Duncan Range Results	CV > PV&C	CV > C > PV	CV > PV	CV > PV&C	
Job Demands and Worker Health Study Median Scores ¹	2.13	1.83	2.06	—	
	<i>Quantitative Workload</i>	<i>Lack of Self- Esteem*</i>	<i>Role Conflict</i>	<i>Workload Variance</i>	<i>Job Future Ambiguity*</i>
Professional VDT (PV)	3.38	9.96	1.82	2.74	3.04
Clerical VDT (CV)	3.55	12.41	1.71	3.02	3.50
Control (C)	3.60	9.73	1.92	2.87	3.10
Duncan Range Results			CV > PV&C		CV > PV&C
Job Demands and Worker Health Study Median Scores ¹	3.51	—	1.75	2.81	2.70

* $p < 0.01$ using an analysis of variance.** $p < 0.05$.¹ Scales taken from Job Demands and Worker Health (Caplan et al., 1975).

pared with norms, were again found (workload dissatisfaction, boredom, and job future). Job demand stressors which were statistically significant included workload dissatisfaction, boredom, qualitative workload, self-esteem, and job future ambiguity at $p < 0.01$, and role ambiguity at $p < 0.05$. The Duncan Range Test shows that the clerical VDT operators reported higher workload, more boredom, greater workload dissatisfaction, greater job future ambiguity, and lower self-esteem than either the professionals using VDTs or the control subjects. The clerical VDT operators also reported more role ambiguity than the

professionals using VDTs. The professionals using VDTs reported less boredom than the control subjects. The same general pattern of stress response observed for the Work Environment Scale was also seen for the ISR stress dimensions, with the clerical VDT operators showing the highest stress levels, followed by the control subjects and the professional VDT operators.

Table 6 shows the specific job factors (stressors) for which the clerical VDT operators reported more problems than both the professionals using VDTs and the control subjects. These job factors fall into four gen-

TABLE 6

Percentage of VDT Operators and Controls Reporting Frequent Levels of Particular Stressors Showing Significant Differences¹

<i>Stressors</i>	<i>Clerical VDT</i>	<i>Professional VDT</i>	<i>Control</i>
Interesting work	24	76	53
Bored with work	48	15	23
Work is dull	42	13	27
Increased concentration required	45	26	34
Able to choose own work	4	28	18
Dislike workload	45	15	21
Unhappy with workload	36	17	21
Have to work too hard	76	53	61
Behind in work by at least one week	27	10	8
Heavy workload	82	70	73
Dissatisfied with workspace	41	17	18
Have to work too fast	82	65	65
Can set own workspace	41	61	73
Certain in career future	14	37	44
Promotion opportunities	13	37	31
Worry about reprimands	24	3	8

¹ Significant at the 95% confidence level or greater using a Chi-Square test for homogeneity.

eral categories including problems with workload, workspace, boring job tasks, and lack of career development.

Psychological Mood Disturbances

Table 7 shows the mean values for each of the six scales of the Profile of Mood States (McNair, Lorr, and Droppleman, 1971) for the VDT operators and control subjects. Only the fatigue scale showed a significant ($p < 0.01$) difference among the three groups. The cleri-

cal VDT operators reported more fatigue than did either the professionals using VDTs or the control subjects.

Health Complaints

Table 8 lists the health complaints for which there were significant differences between the clerical VDT operators and the control subjects. Twenty-six of the 59 health complaints examined were significantly higher ($p < 0.05$) for the clerical VDT

TABLE 7

Mean Scale Values for Mood States for VDT Operators and Control Subjects

	<i>Anxiety</i>	<i>Depression</i>	<i>Anger</i>	<i>Vigor</i>	<i>Fatigue*</i>	<i>Confusion</i>
Professional VDT	9.7	9.6	9.4	16.6	7.2	6.2
Clerical VDT	10.2	9.7	8.0	16.0	9.0	6.2
Controls	7.9	7.6	7.2	17.2	5.9	4.4
Duncan Range Results					CV > PV&C	

* $p < 0.01$ using an analysis of variance.

TABLE 8

Percentage of Clerical VDT Operators and Control Subjects with Selected Health Complaints Showing a Significant¹ Effect

Health Complaints	Percentage	
	Clerical VDT	Control Subjects
Skin rash	57	31
Irritability	80	63
Fainting	36	17
Nervousness	50	31
Fatigue	74	57
Pain down arm	37	20
Stomach pains	51	35
Change in color perception	40	9
Irritated eyes	74	47
Burning eyes	80	44
Blurred vision	71	35
Eye strain	91	60
Swollen muscles and joints	50	25
Back pain	78	56
Painful or stiff arms or legs	62	35
Painful or stiff neck or shoulders	81	55
Numbness	47	18
Neck pressure	57	34
Difficulty with feet from standing long periods	49	35
Sore shoulder	70	38
Loss of feeling in wrists or fingers	33	11
Neck pain into shoulder	56	19
Hand cramps	49	16
Loss of strength in arms or hands	36	14
Stiff or sore wrists	47	7

¹ $p < 0.05$ using a chi-square test.

operators. These health complaints fell into three general areas of health problems: (1) visual, (2) musculoskeletal, and (3) emotional.

Table 9 lists the health complaints for which there were significant differences ($p < 0.05$) between the professionals using VDTs and the control subjects. There were six health complaints showing a significant difference, with the professionals using VDTs reporting higher levels for three (burning eyes, eye strain, and irritability) and the control subjects reporting higher levels for three (fainting, pain down arms, and colds). Of special interest is the fact that there were more health complaints (33) for which there were

significant differences between the clerical VDT operators and the professionals using VDTs than between the clerical VDT operators and the control subjects. In all cases, the clerical VDT operators had more complaints than the professionals using VDTs. The complaints were essentially visual, musculoskeletal, or emotional in nature.

DISCUSSION

The purpose of this study was to determine through the use of a questionnaire survey if there was a potential health risk from using VDTs at the workplaces investigated. The current investigation utilized a number of

TABLE 9

Percentage of Professionals Using VDTs and Control Subjects with Selected Health Complaints Showing a Significant¹ Effect

Health Complaints	Percentage	
	Professional VDT	Control Subjects
Burning eyes	60	44
Eye strain	78	60
Irritability	76	63
Fainting	8	17
Pain down arm	11	20
Colds and sore throat	49	63

¹ $p < 0.05$ using a chi-square test.

experimental controls such as comparison groups of workers in the same facilities and ordered distribution and collection of questionnaires to ensure standardized procedure wherever possible to provide the "clearest" data for making determinations of health risk and increasing the overall usefulness of the data. This evaluation may have limited generalizability, since the study sites were not selected at random, but rather were known sources of union complaints about health problems. Moreover, participants were not selected randomly, but were volunteers, and difficult labor negotiations were underway at the time of the data collection.

All groups evaluated, including the control subjects, reported high levels of psychosocial job stress when compared to worker groups examined using similar measures in previous studies (Insel and Moos, 1974; Caplan et al., 1975). One explanation for this heightened stress level for both the VDT operators and control subjects is that it may have been due to the strained employee/management relations, which were alluded to above. While this factor was not measured in the survey, strained relations produced by difficult labor negotiations could have accounted for the increased stress. The control subjects in particular had work circumstances that could have increased their overall job stress level. At one

site many of the control subjects were aware that they might lose their jobs by the end of the year due to a business slowdown and that those who would be retained would become VDT operators. Also, at the other four sites, the control subjects knew they would be converting to VDTs within months. Such factors most likely contributed to an elevation in stress for the control subjects. This elevation may account for the lack of extensive differences in stress level and health complaints between the control subjects and the professionals using VDTs; however, other factors described later may also have contributed to this result.

The major finding of this investigation is that working with VDTs is associated with high levels of job stress and certain types of health complaints. Clerical VDT operators showed much higher levels of visual, musculoskeletal, and emotional health complaints, as well as higher job stress levels, than did control subjects and professionals using VDTs. However, there were very few differences between control subjects and professional VDT operators. One interpretation of this result is that VDT use tended to have a greater effect on those aspects of the job that were stress producing, such as the conditions that were inherent in the clerical job activities, with little effect on the less

stressful job activities such as those in the professional work. This conclusion cannot be made definitely, since the investigation did not contain a professional group not using VDTs that could be compared to the professional VDT operators. However, the results do suggest that there is a relationship between job activities and VDT use that brings about job stress and health complaints, and that the problem does not lie solely with VDT use.

Yet part of the impact on the clerical VDT operators was most likely a function of VDT use, since the VDT imposes physical stressors that other office machines or hand work do not. These include the visual load due to screen viewing and the additional postural requirements for viewing and keying. The higher level of visual and musculoskeletal complaints reported by the VDT operators, particularly the clerical operators, would tend to verify that the physical aspects of VDT use do adversely affect the operators. However, there was not a strong relationship between the amount of time spent working at the VDT and the resultant health complaints, since there was only a slight positive correlation (Pearson $r = 0.19$, $p < 0.01$) between the number of hours working on the VDT and the total number of health complaints. While this correlation is statistically significant, the overall relationship is not great. Therefore, it seems likely that there must be other factors beyond the physical presence of the VDT that contribute to the health complaints and stress level of the clerical operators. One such factor may be job content.

An examination of the job features of the various groups shows that the clerical VDT operators held jobs involving rigid work procedures and high production standards, constant pressure for performance, very little operator control over job tasks, and little identification with and satisfaction from the end product of their work activity. In contrast to

the clerical VDT operators, the professionals using VDTs held jobs that allowed for flexibility, control over job tasks, utilization of their education, and a great deal of satisfaction and pride in their end product. While both jobs had tight deadline requirements, the professional operators had a great deal of control over how these would be met. In their case, the VDT was a tool that could be used for enhancing their end product, while for the clerical VDT operators, the VDT was part of a new technology that took more and more meaning out of their work. It is not surprising that the professionals using VDTs did not report levels of job stress as high as the clerical VDT operators. In fact, when the significant stress findings are examined, a pattern appears in which the professionals using VDTs reported the lowest stress levels, while the clerical VDT operators reported the highest stress levels, with the control subjects in the middle. This suggests that the use of the VDT is not the only factor contributing to operator stress levels and health complaints, but that job content also makes a contribution.

As stated earlier, the group of control subjects had job tasks similar to those of the clerical VDT operators, with the exception that they did not use a VDT. Their job demands in terms of workload were about the same as for the clerical VDT operators, but they were able to set their workspace within each workday. On the other hand, the clerical VDT operators were monitored closely by the computer systems which provided up-to-the-minute performance reports to supervisors on the rate of production and error levels. This produced feelings in the clerical VDT operators that they were being constantly "watched" by the computer and controlled by the supervisor.

IMPLICATIONS

The comparison of the working conditions for the various groups demonstrates that

those working conditions that led to the stress problems reported that were by the clerical VDT operators are not solely related to the VDT viewing, but are related to the whole VDT work system. In the case of the clerical VDT operators, the computer system technology under which they worked was designed without regard to the "human" factor in the system. In essence, the design reflected the VDT and computer capabilities and performance functions which were then imposed on the operator. Basically, the use of the VDT was a secondary influence on the job task activities as compared to the influence of the total computer system and its requirements. This is a serious concern since the persons who design systems such as these, and thereby the work activities of VDT operators, are typically computer scientists and systems analysts who have little appreciation of the human element in such a work situation. This leads to a dehumanization of the work activity that is similar to that produced by the introduction of assembly lines in manufacturing industries. In fact, such offices become "paper factories" with clerical assembly lines in which the work content is simplified to increase "thru-put" and capitalize on computer capabilities. These jobs produce boredom and dissatisfaction. The machinery becomes a source of misery for clerical workers, rather than the helpful tool that it is for the professionals using the VDTs.

Such a work environment also brings about worker fears that further automation and computerization of their job may lead to job loss or downgrading to a lower level job. The high level of job future ambiguity and concerns about career development shown by the clerical VDT operators in this investigation demonstrates this concern. In addition, almost 50% of the clerical VDT operators reported that it would be likely that they would be replaced by a computer at some time in the future.

Those stress factors that displayed significant differences between the clerical VDT operators and both the professionals using VDTs and the control subjects dealt mainly with the work content, workload, and career concerns. The clerical VDT operators reported jobs that were dull and boring with a great deal of structure and control in terms of both the job task requirements and supervision. They felt that the workload was very heavy, that the workplace was too fast, and that they had little control over the pacing. This resulted in their low ratings of job involvement and job autonomy, with greater role ambiguity than the other groups. These workers were not sure what their jobs required of them and felt they had very little control over or input to job requirements. They saw themselves in a highly controlled work environment that demanded high productivity.

This work atmosphere led to a very low rating of peer cohesion and staff support, as well as concerns about their job future. Of course such feelings are not unusual with clerical jobs, since these jobs have inherent aspects which make them repetitious and structured. However, the main difference with these clerical VDT workers is the unusual lack of control over the work process which was imposed by the computer system under which they worked. Also, this same work system provided much closer tracking of their performance than traditional "paper pushing" systems. It is possible that their concerns about workplace and workload were related more to how closely these factors were monitored than to the physical nature of the work. The inflexibility of this work system and the directive/corrective management style that it engenders seem to produce a feeling of loss of control over work activity; this feeling may be the root problem of such workers.

While the other two groups also reported

higher stress levels than were reported in previous studies, neither was as high as those of the clerical VDT operators. In fact, the professional VDT operators reported the highest levels of job involvement and autonomy with the lowest levels of work pressure and workload difficulties of all the groups, while showing the most peer cohesion and staff support and the least boredom, role ambiguity, and job future ambiguity. This group also had the lowest number of health complaints. The evidence from the stress evaluation supports the idea that VDT use per se is not completely responsible for the type of stress problems, the overall stress level, or the health complaints. More likely, other factors such as job content and the work system are major contributors to the stress problems observed by the clerical operators.

There were a number of health complaints reported more frequently by the VDT operators than the control subjects. These can be grouped into visual, musculoskeletal (mainly muscular), and emotional problems. The clerical VDT operators had considerably more of these health complaints than either the professionals who used VDTs or the control subjects. In fact, there were greater differences between the clerical VDT operators and the professional VDT users than between the clerical operators and control subjects. This may demonstrate a relationship between job stress level and level of health complaints. However, such a relationship would be difficult to verify based on the current investigation, which has no professional control group.

While a good many of the job stress problems identified in this investigation can be traced to the job content of the participants, the type of health complaints voiced are indicative of problems of a different nature. Specifically, they are those problems that deal with the design of the workstation and the surrounding environment. Both clerical VDT

operators and professional VDT operators reported significantly more vision problems than the control subjects. These vision problems encompassed complaints such as burning eyes, eye strain, blurred vision, irritated eyes, and even reports of changes in ability to see colors. These data indicate that the use of the VDT increased acute vision problems as reflected by operator reports. These problems could be related to workload, but, as stated earlier, the correlation between hours worked and health complaints was quite small, even though it was statistically significant.

The basic conclusion that can be drawn from this investigation is that a number of interacting factors including job task related features (job content, task requirements, workload) and environmental factors (lighting, workstation design) contributed to the observed levels of job stress and health complaints. The work system imposed by the use of VDTs may also contribute to the observed health problems, although it was not possible to clearly make this determination based on the current investigation. Because of this, solutions for dealing with potential health problems posed by VDTs must encompass both job redesign and workplace redesign factors to deal with all the root causes of the problems. Additionally, the design of computerized office systems cannot be left solely to computer experts who are concerned mainly with the capabilities and needs of the machinery of the system, but must have significant input from human factors experts who can take account of the needs of the "people component" of the system.

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