

HEALTH HAZARDS OF WORK ON VISUAL DISPLAY UNITS (VDUs)

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SYNOPSIS

The symptoms of eyestrain (tense, heavy eyes/tired, tearing of eyes, dry eyes, burning sensation over the eyes, twitching of eye muscles, double and/or blurring of vision) headache and muscular ache (neckache, backache, arm and shoulder ache) were evaluated among 233 VDU operators employed in a telecommunications company.

There was no significant difference in the prevalence of symptoms between the subjects and controls. The majority of the subjects and controls developed symptoms of eye strain and muscular strain after the first 2 hours of work. Those who worked more than 8 hours (in a day at one stretch) had symptoms of eye strain (blurring and/or double vision) more commonly (53.8%) than those who did not work more than 8 hours a day (35.9%). There was no deterioration in visual acuity in VDU operators who worked less than 3 years.

INTRODUCTION

VDUs are becoming increasingly common in offices and other working environments. Not only are they being used regularly by more people than a decade ago, they are also being used more intensively and are also going into homes.

Generally, work on VDUs poses no risk to health for most operators. Studies (1, 2, 3, 4, 5, 6) have shown that radiation emission from VDUs does not in any way pose a danger to operators working at or near the terminals. In some instances, however, operators especially after working for prolonged and uninterrupted periods may experience eyestrain, headache, tiredness, muscle-ache and other VDU-related stress (7, 8, 9, 10). The objective of this survey was to evaluate these symptoms in a large telecommunication company using VDUs. Radiation, which poses no danger to the health of the operators was excluded from this study.

METHODS AND MATERIALS

Arrangements were made to examine VDU operators in the 5 VDU stations where work on the VDUs was continuous for 7 or more hours. For those workstations with more than 50 operators, only 50 were randomly selected for study. They were matched with controls by sex, ethnic group and age. These control workers were chosen from another section of the company not using VDUs but whose job requirements were comparable with VDU work. A total of 233 VDU operators and 73 controls were studied. Each subject was examined for far visual acuity, near visual acuity and colour blindness. A self-administered questionnaire on personal characteristics, symptoms of VDU related stress over the last 3 months, (viz eyestrain, headache, muscle ache, their relationship to the nature of work and rest breaks and the occurrences of these symptoms to the duration of work on the VDUs) was completed in the presence of the authors. No time limit was given and they were not allowed to discuss their answers with each other. An attempt was made to retrieve all available pre-employment eye test results for comparison to evaluate whether there was evidence of eye sight deterioration with time. Measurements were made of the general illumination levels and the screen luminance by means of a Hagner photometer (Model S1). The meter was colour and cosine connected.

RESULTS AND DISCUSSION

Study Population

A total of 233 VDU operators from 5 VDU workstations and 73 controls were studied.

The mean age of the VDU operators was 25.8 and of their controls was 26.2. All were females and had at least a GCE 'O' level qualification. 58.7% of the VDU operators were married females as compared to 57.5% of their controls.

Nature of Work

The main tasks of these VDU operators were to attend to calls and to enter alpha-numeric information through the VDU to the main computer to check information. The controls attended to the booking and connection of calls. Their work was thus similar to that of the VDU operators except that no VDUs were required. All worked in air-conditioned rooms with an average humidity of 60%. They worked an average of 8 hours on their jobs and were entitled to a 20 minute break after two and a half to about three and a half hours of

work at staggered times. This is exclusive of a lunch-break.

General Illumination

The general illumination ranged from 130 to 590 lux in the various workstations (for both VDU and non-VDU work) (Table 1). This was below the recommended levels for visual tasks at computer terminals (8, 11).

TABLE 1: GENERAL ILLUMINATION OF THE WORKSTATIONS

Work-stations	General illumination (lux)		Recommended illumination (lux)
	Range	Mean	
A	130-240	200	600 (11) 500-700 (8)
B	220-310	270	
C	190-290	230	
D	210-300	270	
E	310-590	460	
F (controls)	150-200	170	

There is considerable variation in the literature (5, 8, 11, 12, 13, 14) regarding the levels of illumination recommended for office work ranging from 150 to 750 lux. The controls workstation had the lowest illumination level. This might have some bearing on the study results.

HSE (5) and Steward (10) suggested an illuminance of between 300-500 lux on the desk surface to be an acceptable compromise for many VDU tasks which also involve paper work. NIOSH (7) recommends illumination levels to be within 500-700 lux, with individual work station lighting provided for jobs requiring higher levels due to visual demands.

It is very difficult to make recommendations about illumination levels if visual tasks requiring different illumination occur in the same work area. Relatively low illumination levels (300-500 lux) appear to be appropriate for VDT use, with higher levels (1000-1600 lux) being indicated for other visual tasks, particularly those which require the reading of poor quality hard copy. We recommend an illumination level of at least 300 lux in their work stations in view of the moderate visual demands of their jobs.

VDU Screen Luminance

All the VDUs except VDUs in workstation B had a screen luminance less than the recommended 75-150 candelas/m², recommended by NIOSH (8).

Prevalence of symptoms

On the whole, there was no significant difference in the prevalence of the various symptoms between VDU and non-VDU operators except for arm and shoulder ache which was more prevalent among the control subjects (Table 2).

This could be related to the need to stretch out their arms in order to key numbers onto a fixed keyboard. This symptom was also higher in those who worked overtime (Table 3).

There appeared to be no significant differences in the prevalence of various symptoms between VDU and control subjects. The lower illumination of the controls' workstation may have contributed to this finding.

When the symptoms were further analysed, we

TABLE 2: DISTRIBUTION OF SYMPTOMS DURING THE PRECEDING 3 MONTHS AMONG VDU AND NON-VDU OPERATORS

Type of Symptoms	operators (n = 233)	Non-VDU operators (n = 73)	X ² c	P
1. Heavy/tired eyes	128	46	1.1678	> 0.05
2. Tearing of eyes	52	21	0.9423	> 0.05
3. Dry eyes	23	5	0.3012	> 0.05
4. Burning sensation over the eyes	48	19	0.6661	> 0.05
5. Twitching of eye muscles	41	15	0.1565	> 0.05
6. Double vision	27	12	0.7802	> 0.05
7. Blurring of vision	85	27	0.0037	> 0.05
8. Headache	123	38	0.0006	> 0.05
9. Neckache	106	24	3.1232	> 0.05
10. Backache	106	35	0.0539	> 0.05
11. Arm and shoulder ache	55	28	5.3952*	< 0.05

Note: a) An operator may have more than 1 symptom.

b) *Statistically significant at the 5 percent level.

TABLE 3: PREVALENCE OF ARM AND SHOULDER ACHE AMONG CONTROL SUBJECTS IN RELATION TO OVERTIME WORK

Overtime Work (exceeding 8 hours/day)	Total No. of subjects	Symptoms of arm and shoulder ache	
		Present	Absent
Overtime work	11	8 (72.7%)	3 (27.3%)
No overtime work	62	20 (32.3%)	42 (67.7%)

(x²c = 4.8728; p < 0.05)

found no correlation with age and visual acuity. Interestingly, married and divorced VDU operators had significantly higher prevalence of headache, neckache, backache and arm and shoulder ache than their single female VDU operators (X²c = 5.6726; p < 0.05). The added housework at home could have contributed to their symptoms as there was no significant difference in their mean age. (Their mean age being 24.1 years and 27.5 years for the single females and married or divorced females respectively).

Most of VDU and non-VDU operators appeared to have one or more symptoms after the first 2 hours of work (Table 4). Thus, if symptoms were to be minimised, breaks of approximately 15 minutes should preferably be given after every 2 hours of work for all these operators. This is considered adequate for our study group as work load is considered moderate and VDU operators occasionally do non-VDU work. Most guidelines provide for a 10-15 minutes break after every 2 hours for VDU operators under moderate visual demands and 10 minutes every hour for operators under high visual demand (4, 8, 13, 17).

These breaks should be used by the operator to relax, to exercise their bodies or to engage in an appropriate amount of active exercises. It is desirable to give consideration to a combination of VDU and non-VDU work. Pauses at the VDU work as the operator waits for the material to appear on the screen

should not be taken as breaks because these are not under the control of the operator and are of unpredictable length. These pauses may actually cause more stress.

While many of the symptoms were experienced by both VDU and non-VDU operators, studies (8, 12, 15) showed that these were directly related to the intensity and duration of work on the VDUs. Workers using VDUs for 7-8 hours per day experienced visual and muscular symptoms about 2-3 times more often than workers using VDUs for 2 hours or less (15). In our study, increasing the duration of work on the VDU increases the prevalence of symptoms, especially that of double vision and blurring of vision. This relationship was not seen in the non-VDU group (Table 5).

53.9% of the VDU operators who worked overtime (exceeding 8 hours a day) as compared to 35.9% of those who did not work overtime had significantly higher symptoms of double and/or blurring of vision. Thus, overtime work should preferably be reduced for VDU operators.

Headache

Some of the VDU operators attributed the cause of headache to the use of headphones. We found that VDU operators using headphones suffered significantly more headaches when compared to those not using them, while there was no significant difference in the prevalence of headaches among non-VDU operators using or not using the same type of headphones (Table 6). Thus, it appears that VDU work in combination with the use of headphones may aggravate the symptoms of headache.

Visual Deterioration

When the current far visual acuity results were compared to their respective pre-employment eye-test results, we found no evidence to suggest deterioration in visual acuity for VDU operators who worked with VDUs for a period of less than 3 years. This concurs with some studies which suggest no evidence of eyesight deterioration/damage in VDU operators (6, 12, 13). Unfortunately, for VDU operators who have worked

TABLE 4: SYMPTOMS BY TIME OF ONSET

Type of Symptom	Duration of work before onset of symptoms	VDU Operators			Non-VDU Operators		
		No	%	Cumulative %	No	%	Cumulative %
Heavy eyes and/or Tearing of eyes and/or Dry eyes and/or Burning sensation and/or Twitching of eyes muscles	<1 hour	11	13.2	13.2	9	23.7	23.7
	1 – <2 hours	17	20.5	33.7	8	21.1	44.8
	2 – <3 hours	33	39.8	73.5	7	18.4	63.2
	>3 hours	22	26.5	100	4	36.8	100
Double and/or blurring visioin	<1 hour	7	14.9	14.9	3	23.1	23.1
	1 – <2 hours	8	17.0	31.9	1	7.7	30.8
	2 – <3 hours	12	25.5	57.4	4	30.8	61.6
	>3 hours	20	42.6	100	5	38.4	100
Headache and/or Neckache and/or Backache and/or Arm and shoulder ache	<1 hour	11	13.9	13.9	5	15.2	15.2
	1 – <2 hours	12	15.2	29.1	11	33.3	48.5
	2 – <3 hours	36	45.6	74.7	8	24.2	72.7
	>3 hours	20	25.3	100	9	27.3	100

TABLE 5: RELATION BETWEEN VISUAL SYMPTOMS AND OVERTIME WORK

Operators	Blurring and/or double vision		X ² c	P
	Present	Absent		
VDU operators				
— Work overtime	28 (53.9%)	24 (46.1%)	4.6956*	<0.05
— No overtime work	65 (35.9%)	116 (64.1%)		
Non-VDU operators				
— Work overtime	6 (54.5%)	5 (45.5%)	0.4242	>0.05
— No overtime work	24 (38.7%)	38 (61.3%)		

TABLE 6: PREVALENCE OF HEADACHE AMONG VDU AND NON-VDU OPERATORS IN RELATION TO THE USAGE OF HEADPHONES

Operators	Usage of headphones	Headache		X ² c	P
		Present	Absent		
VDU	Yes	86 (62.3%)	52 (37.7%)	11.4120*	<0.01
	No	37 (38.9%)	58 (61.1%)		
Non-VDU	Yes	37 (53.9%)	33 (46.1%)	0.3248	>0.05
	No	1 (33.3%)	2 (66.7%)		

for 3 or more years, no pre-employment visual examination results were available for comparison. No near visual acuity was done at pre-employment for evaluation. Nevertheless, health and safety personnel should be alerted to the problems of eyestrain. Most studies (8, 10, 12, 13, 17) recommends that all VDU operators should have a pre-employment and periodic eye examination. We (16) recommend eye tests for far and near visual acuity and for colour vision before an operator starts work on the VDU and an annual eye examination for far and near visual acuity. We also suggest that VDU operators have a visual acuity which is adequate for the size of the characters to be displayed on the VDU screen and that there should be no central field defects in both eyes.

CONCLUSION

From the findings of the present study, it is apparent that work on VDUs presents no major health problems in the operators. However, with prolonged hours of work, some operators may experience double and/or blurring of vision.

Most people still express concern about the possible ill effects of VDU work in view of the increasing number of workers who will be exposed in future. Whether or not prolonged eyestrain causes permanent damage is in many ways a medico-legal question. It certainly detracts from the well-being and efficiency of user and should therefore be eliminated.

As a result, many countries, eg America (8), United Kingdom (5) and Japan (7) have set up guidelines on the safe use of VDUs. These include specifications on the working conditions (illumination, lighting, prevention of glare), work procedures and equipment (chair, VDT equipment), medical examinations and certification of fitness for such work.

ACKNOWLEDGEMENT

We are grateful to the Permanent Secretary (Labour) for permission to quote from department records.

We would like to thank Mr Yong Swee Keong, Ms Pang Hwee Leng and Miss Lee Lee Choo for their invaluable assistance in this study. Last but not least, we would also like to thank the management and staff of the Telecommunications of Singapore who participated in this study for their generous co-operation.

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