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The Influence of Visual Display Terminal Use on the Physical and Mental Conditions of Administrative Staff in Japan

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Abstract Visual display terminals (VDT) are standard equipment for many office workers. Their use, however, may increase the risk of developing adverse conditions related to vision, the musculoskeletal system, and mental health. We carried out a survey among 3070 workers aged 18 to 67 years (mean, 39.9 years) at a prefectural administrative office, in which 76% of subjects were visual display terminal (VDT) users. We examined the relationship between duration of daily VDT use and eyestrain, neck or upper extremity pain, back pain, and mental health, and estimated the effect of breaks and rest during VDT work on these symptoms. The 12-item General Health Questionnaire (GHQ-12: total scores ranged from 0 to 12) was used to identify potential poor mental health status, and subjects with 4 or more were considered to have symptoms of psychological distress. Seventeen percent of subjects reported eyestrain, 19.1% reported upper extremity pain, 11.6% reported back pain, and 17% of subjects had GHQ-12 scores of 4 or higher. Logistic regression analysis showed that duration of daily VDT use and lack of breaks and rest during VDT work were significantly associated with eyestrain, neck or upper extremity pain, back pain, and psychological distress. In order to protect users from the adverse effects associated with VDT work, reducing daily VDT exposure, taking breaks, and rest during VDT work are important. *J Physiol Anthropol 26(2): 69–73, 2007* http://www.jstage.jst.go.jp/browse/jpa2
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Introduction

The visual display terminal (VDT) is standard equipment for many office workers in industrialized societies, and its use is growing. Several studies have shown that VDT users may be at increased risk of developing adverse conditions related to vision, the musculoskeletal system, and mental health (Gerr et al., 1996; Jaschinski et al., 1998; Smith, 1997). To protect workers from the adverse effects of VDT, the Japanese Ministry of Labour has published guidelines for VDT work (Japanese Ministry of Labour, 1984; 2002). The World Health Organization (WHO) also has published recommendations concerning the use and system design of VDTs (WHO, 1989). Together these suggest the need to design jobs including task analysis, training and skill enhancement, minimization of daily VDT use, and increase of the length of rests during VDT work.

Several studies have confirmed relationships between VDT use and physical symptoms (Polanyi et al., 1997; Rossignol et al., 1987) or mental symptoms (Carayon, 1993; Lindstrom, 1991; Tachibana et al., 1998). Others have failed to observe a relationship between VDT use and physical symptoms (Fahrbach and Chapman, 1990; Shima et al., 1993; Sugita et al., 1986) or mental symptoms (Starr et al., 1985; Tarumi et al., 1990). Thus, the effects of techno-stress through VDT use on physical or mental distress are still controversial. In addition, relatively few studies have investigated the effect of breaks and rest during VDT work. Therefore, our study was designed to examine the relationship between duration of daily VDT use and symptoms related to vision, the musculoskeletal system, and mental health, and estimate to what extent breaks and rest during VDT work affect such symptoms.

Subjects and Methods

The study population consisted of 3380 prefectural administrative officers. The main VDT tasks, according to the category of VDT operation (Japanese Ministry of Labour, 2002), were interactive, simple data entry, and technical tasks. After obtaining informed consent, we carried out our survey using questionnaires in 2003.

Subjects were asked about their age, sex, hours of daily VDT use, the presence/absence of rest and breaks during VDT work, eyestrain, and musculoskeletal pain. Eyestrain included the presence of blurred vision, blinking, ocular soreness, itchy eyes, heaviness of the eyes, and double vision during or soon after completing work. Musculoskeletal pain (neck or upper extremity pain, back pain) was defined by aches, pain, or discomfort in the neck, shoulders, elbows, hands, and back during the last month. We defined "rest" and a "break" according to the guidelines for VDT work published by the Japanese Ministry of Labour. Regarding "rest", subjects were asked, "One continuous operation time must not exceed one hour; do you take an operation downtime of 10–15 minutes before subsequent continuous operation?" Regarding a "break, subjects were asked, "Do you take one or two short breaks within one continuous operation time?"

The Japanese version of the 12-item General Health Questionnaire (GHQ-12) was used to identify potential poor mental health status (Goldberg et al., 1997; Honda et al. 2002). Total scores ranged from 0 to 12, where higher scores indicated more symptoms of psychological distress. Subjects with GHQ-12 scores of 4 or more were classified as the GHQ-12 high score group, and subjects with GHQ scores of 3 or less were classified as the GHQ-12 low score group (Goldberg and Williams, 1988).

Subjects with missing information were excluded from analysis, leaving 3070 (91%) subjects for data analysis. Differences of mean age among duration of daily VDT use and breaks/rest situations were evaluated using one way ANOVA followed by Duncan's multiple-range test for post hoc comparisons. The chi-square test for categorical variables was used to examine the differences in proportions of women among daily VDT use and breaks/rest situations. Since duration of the daily VDT use and breaks/rest situations were ordinal variables, we conducted a test for overall trend: Linear trends for frequency of eyestrain, neck or upper extremity pain, back pain, and high GHQ-12 scores were tested by the Cochran-Armitage test for trend. Logistic regression was performed to estimate the odds ratios (OR) and 95% confidence intervals (95%CI) of eyestrain, neck or upper extremity pain, back pain, and high GHQ-12 scores for each duration of the daily VDT use and breaks/rest situations, using the non-users group as reference, with adjustment for age and sex. In order to test the linear trends in odds ratios, we coded duration of daily VDT use and breaks/rest situations to be ordinal variables, and incorporated these data into the logistic model as a single variable (Barlow et al., 2006). All statistical analyses were performed using SAS software, version 8.2 (SAS Institute Inc., Cary, NC, USA).

Results

Selected characteristics of the subjects are summarized in Table 1. The subjects aged from 18 to 67 years (mean; 39.9 years, SD; 10.7) with one-fourths being women and three-fourths being VDT users. Seventeen percent of subjects reported eyestrain, 19.1% reported upper extremity pain, 11.6% reported back pain, and 17% of subjects had GHQ-12 scores of 4 or higher. Among VDT users, 34.3% had breaks and rest, 34.9% had either breaks or rest, and 30.7% had neither break nor rest.

Table 2 stratifies the subjects by duration of daily VDT use. Subjects using VDTs more than 5 hr/day were significantly younger than those using VDTs less than 5 hr/day and non-users ($p<0.001$). Compared with non-users, the proportion of women was significantly lower in VDT users ($p<0.001$). With increasing duration of daily VDT use, the frequency of reporting eyestrain, neck or upper extremity pain, back pain, and high GHQ-12 scores significantly increased (p-trend <0.001).

When considering breaks and rest situations during VDT work (Table 3), VDT users with either breaks or rest and without break and rest were significantly younger than those using VDTs with breaks and rest and non-users ($p<0.001$). There was a progressive increase in frequency of the above-mentioned symptoms and high GHQ-12 scores observed with decreased breaks and rest during VDT work (p-trend <0.001).

Age- and sex-adjusted logistic regression analyses showed that longer daily VDT use was significantly associated with

Table 1 Selected characteristics of the study population (n=3070)

	Number	%
Age (years)		
18–29	647	21.0
30–39	976	31.8
40–49	680	22.2
50–67	767	25.0
Gender		
Women	714	23.3
Men	2356	76.7
Daily VDT use		
Non-user	743	24.2
<5hr	1565	51.0
≥5hr	762	24.8
Symptom		
Eyestrain	506	16.5
Neck or upper extremity pain	586	19.1
Back pain	357	11.6
High GHQ-12 scores	523	17.0
Breaks and rest situation during VDT work (user n=2327)		
Breaks and rest	799	34.3
Either breaks or rest	813	34.9
Neither break nor rest	715	30.7

eyestrain, neck or upper extremity pain, back pain, and high GHQ-12 scores, as compared with non-users (Table 4, *p*-trend <0.01). In Table 5, compared with non-users, breaks/rest situations during VDT work were significantly associated with physical symptoms, and the risk of developing physical symptoms increased with decreased break or rest (*p*-trend <0.001). Although breaks and rest and either breaks or rest were not associated with high GHQ-12 scores, compared with non-users, neither breaks nor rest was significantly associated. However, the risk of developing high GHQ-12 scores increased with decreased break or rest (*p*-trend <0.001).

Table 2 Comparison of subjects according to duration of daily VDT use (n=3070)

	VDT use			*p* value
	Non-user (n=743)	<5 h/day (n=1565)	≥5h/day (n=762)	
Mean (SD)				
Age (years)	41.2 (11.7)	41.4 (10.1)	35.6 (9.5)	<0.001$
Number (%)				
Women	225 (30.3)	335 (21.4)	154 (20.2)	<0.001#
Eyestrain	50 (6.7)	267 (17.1)	189 (24.8)	<0.001*
Neck or upper extremity pain	80 (10.8)	325 (20.8)	181 (23.8)	<0.001*
Back pain	56 (7.5)	197 (12.6)	104 (13.7)	<0.001*
High GHQ-12 scores	114 (15.3)	242 (15.5)	167 (21.9)	<0.001*

$ One way ANOVA; # Chi-square test; * Cochran-Armitage test for trend

Discussion

The present study detected a relationship between duration of daily VDT use and eyestrain, neck or upper extremity pain, back pain, and high GHQ-12 scores among Japanese administrative staff. For VDT users, breaks and rest during VDT work were found to be protective against such symptoms.

Our findings support previous studies with respect to the increased prevalence of adverse conditions pertaining to vision

Table 4 Age- and sex-adjusted odds ratios (OR) and 95% confidence intervals (95%CI) for eyestrain, neck or upper extremity pain, back pain and high GHQ-12 scores with respect to duration of daily VDT use (n=3070).

	OR (95%CI)			*p*-trend
	Non-user	<5 hr/day	≥5hr/day	
Eyestrain	1.0	3.1 (2.3–4.3)	5.4 (3.8–7.5)	<0.001
Neck or upper extremity pain	1.0	2.4 (1.9–3.2)	3.2 (2.4–4.3)	<0.001
Back pain	1.0	1.9 (1.4–2.6)	2.2 (1.6–3.2)	<0.001
High GHQ-12 scores	1.0	1.1 (0.8–1.3)	1.6 (1.2–2.1)	0.002

Table 3 Comparison between VDT users and non-users considering breaks and rest situations during VDT work (n=3070)

	Non-user (n=743)	Breaks and rest (n=799)	Either breaks or rest (n=813)	Neither break nor rest (n=715)	*p* value
Mean (SD)					
Age (years)	41.2 (11.7)	41.6 (10.6)	38.7 (10.3)	38.2 (9.7)	<0.001$
Number (%)					
Women	225 (30.3)	174 (21.8)	166 (20.4)	149 (20.8)	<0.001#
Eyestrain	50 (6.7)	112 (14.0)	169 (20.8)	175 (24.5)	<0.001*
Neck or upper extremity pain	80 (10.8)	136 (17.0)	196 (24.1)	174 (24.3)	<0.001*
Back pain	56 (7.5)	88 (11.0)	115 (14.2)	98 (13.7)	<0.001*
High GHQ-12 scores	114 (15.3)	110 (13.8)	126 (15.5)	173 (24.2)	<0.001*

$ One way ANOVA; # Chi-square test; * Cochran-Armitage test for trend

Table 5 Age- and sex- adjusted odds ratios (OR) and 95% confidence intervals (95%CI) for eyestrain, neck or upper extremity pain, back pain, and high GHQ-12 scores according to breaks and rest during VDT use (n=3070)

	OR (95%CI)				*p*-trend
	Non-user	Breaks and rest	Either breaks or rest	Neither break nor rest	
Eyestrain	1.0	2.5 (1.7–3.5)	4.1 (2.9–5.8)	5.1 (3.6–7.2)	<0.001
Neck or upper extremity pain	1.0	1.9 (1.4–2.6)	3.1 (2.3–4.2)	3.2 (2.4–4.3)	<0.001
Back pain	1.0	1.6 (1.1–2.3)	2.2 (1.6–3.1)	2.2 (1.5–3.1)	<0.001
High GHQ-12 scores	1.0	0.9 (0.7–1.2)	1.1 (0.8–1.3)	1.8 (1.4–2.3)	<0.001

and the musculoskeletal system among VDT users (Polanyi et al., 1997; Rossignol et al., 1987). Possible explanations for the increased prevalence of symptoms related to vision include adverse effects of glare, poor contrast, and constant focusing (Rossignol et al., 1987). The increased prevalence of musculoskeletal symptoms may have resulted from constrained posture and static loading of muscles (Polanyi et al., 1997). In addition, factors such as work load, job demands, job control, and social support may modify the effect of VDT use on vision and the musculoskeletal system (Mocci et al., 2001).

In contrast to physical symptoms, relatively few studies have investigated associations between VDT use and mental symptoms. Tarumi et al. (1990) reported that psychological symptoms were less common than musculoskeletal symptoms. Tachibana et al. (1998) found that VDT use was significantly associated with sleep-related symptoms. Nakazawa et al. (2002) showed that the prevention of mental disorder and sleep disorder requires the restricted VDT use to less than 5 hours per day. In our study, using VDTs $\geq$5 hr/day was significantly associated with high GHQ-12 scores, suggesting that longer daily VDT use may result in deterioration of mental health status. As even subjects with low GHQ-12 scores may have a certain degree of psychological distress, we should make such people aware of their mental health.

With regard to breaks and rest during VDT work, Boucsein and Thum (1995) recommended users take a 7.5-minute rest after every 50 minutes of VDT work until noon and a 15-minute rest after every 100 minutes of VDT work in the afternoon. Balci and Aghazadeh (2003) compared three different work-rest schedules (60-minute work/10-minute rest, 30-minute work/5-minute rest, and 15-minute work/micro breaks) of VDT operators performing data entry and mental arithmetic tasks. They found that the 15-minute work/micro breaks schedule resulted in the lowest discomfort in the neck, lower back and chest, but the 30-minute work/5-minute rest schedule resulted in the lowest eyestrain and blurred vision. In our study, VDT users lacking breaks and rest were at excess risk of developing eyestrain, neck or upper extremity pain, back pain, and high GHQ-12 scores. Although improved work design as well as work and social environments can facilitate the reduction of the physical and mental symptoms associated with VDT use, breaks and rest during VDT work are effective and can easily be applied.

In most studies, which have failed to observe a significant relationship between VDT use and physical or mental symptoms, the sample size was less than one thousand without a comparison population. Therefore, we conducted an extensive survey on a group of over 3000 workers and included non-users as comparison population, providing a reliable estimate. Some work-related aspects such as job demands, job content, career opportunities, and social support, potentially contribute to these symptoms, but were not available in this study. Future studies are required to answer such questions.

In conclusion, VDT use was significantly associated with eyestrain, neck or upper extremity pain, back pain, and poor mental health status. To protect users from the adverse effects of VDT work, reducing daily VDT to less than 5 hr/day as well as increasing breaks and rest is important.

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