

Development of Action Checkpoints for Comfortable Computer Work

Kazuyuki IWAKIRI^{1*}, Ippei MORI¹, Midori SOTOYAMA¹, Kaori HORIGUCHI²,
Takanori OCHIAI², Hiroshi JONAI³ and Susumu SAITO¹

¹National Institute of Industrial Health, 6-21-1, Nagao, Tama-ku, Kawasaki, Kanagawa 214-8585, Japan

²Fujitsu Limited, 4-1-1, Kamikodanaka, Nakahara-ku, Kawasaki, Kanagawa 211-8588, Japan

³Nihon University, 1-8-14, Kandasurugadai, Chiyoda-ku, Tokyo 101-8308, Japan

Received February 19, 2004 and accepted March 3, 2004

Abstract: We developed a manual including a checklist format for undertaking measures to prevent fatigue in visual display terminals (VDT) workers. With this manual, problems related to VDT work can be recognized by using checklists which allow for self-evaluation by the workers. The manual helps the workers to consider measures for improvement by themselves and will contribute to better occupational health education.

Key words: Visual display terminals (VDT), Checklist, Guidelines, Physical discomfort, Improvement plan

Introduction

Work using visual display terminals (VDT) increases mental and physical fatigue compared with general office work^{1,2}. With the spread of high-performance computers and computer networks, the number of VDT in offices has increased rapidly in recent years³. According to a report of the Ministry of Labour in 1998³, 36.3% of VDT workers experienced mental fatigue and 77.6% physical fatigue. Since the numbers of workers and working hours at VDTs will continue to increase, complaints about VDT work will have also increased.

As measures to prevent fatigue and to realize comfortable VDT operation, “Guidelines for Industrial Health Controls of VDT Operations”⁴ were enacted by the Ministry of Health, Labour and Welfare (MHLW) in 2002. The Guidelines include countermeasures that employers should give assistances to VDT workers to reduce mental and physical fatigue and take actions to maintain worker’s health. However, it is difficult for workers to improve their workplace by themselves.

In order to perform and continue measures for

improvement, it is necessary to provide workers with targets for improvement and motivation. Therefore, we developed “Action Checkpoints for Comfortable Computer Work”, which is a manual including a checklist format for undertaking measures to prevent fatigue. This manual can help workers to recognize problems related to VDT work and motivate them to perform improvements. This manual was established based on the results of our project on the ergonomic aspects of introduction of information technologies in modern offices, and also intended to introduce the guidelines of MHLW in a practical way. The content and usage of the manual are as follows.

Structure of Manual

The manual consists of the following five items.

- 1) *Action Checkpoints (Page 2, Appendix):*
Checklist of problems that workers can recognize by themselves
- 2) *Computer Work and Discomfort (Page 3, Appendix):*
Explanation of risk factors of symptoms of fatigue in relation to VDT work
- 3) *How to use the Action Checkpoints (Page 3, Appendix):*
Usage of the manual

*To whom correspondence should be addressed.

- 4) *Examples of Improvements (Page 4–7, Appendix):*
Proposals for improvements
- 5) *Quick Reference to Reduce Physical Discomfort from Computer Work (Page 8, Appendix):*
The simple checkpoints of factors affecting fatigue during daily computer use

The list of Action Checkpoints and Examples of Improvements include seven areas: (a) air conditioning, (b) computer monitor, (c) hours of computer work, (d) input devices, (e) chair and desk, (f) working space, and (g) social interaction at work. These areas were regarded as the main factors that affect fatigue.

Target Workers and Use of Manual

This manual is targeted toward office workers who use computers for long periods. When considering measures for improvement in working conditions, the worker must discuss the issue with other VDT workers. The discussion has the potential for bringing about a better solution. Moreover, problems in the working environment in relation to the entire office, such as office furniture and workspace, must be discussed with all staff members.

Figure 1 shows procedure for undertaking measures to prevent fatigue in VDT workers by using this manual. Firstly, VDT workers should check the necessity for improvement in the seven areas in the Action Checkpoints. Secondly, they must rank checked areas according to priority based on the findings of self-evaluation. Thirdly, workers should take measures based on examples of improvement plans in each area. It is very important for workers to consider their own measures by themselves.

Conclusion

Occupational health education for workers is one of the effective measures to prevent fatigue in VDT work. Education provided through the use of this manual can be considered to be more effective in preventing fatigue than the usual forms of education because this manual enables workers to perform a self-evaluation. Moreover, education with this manual can be acquired in a short time and special training in its use is unnecessary. This manual is posted on the website of the National Institute of Industrial Health, Japan⁵⁾. Please download the file from the website in order to use the manual.

Usage of Manual

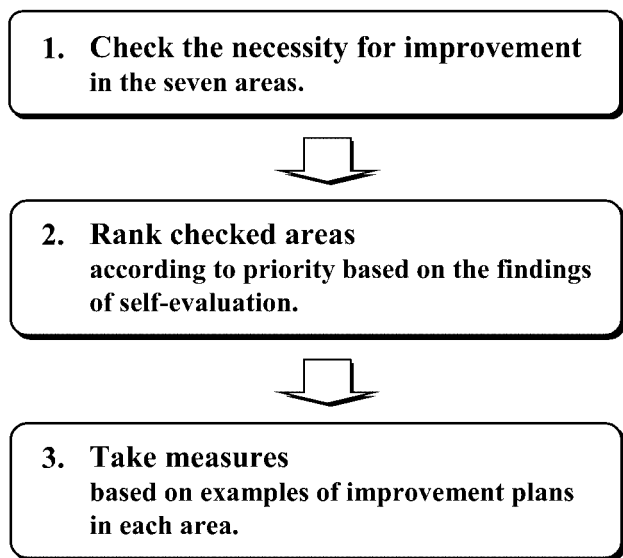



Fig. 1. Procedure for undertaking measures to prevent fatigue in VDT workers by using the Action Checkpoints for Comfortable Computer Work.


Acknowledgments

We thank Dr. Maria Beatriz G. Villanueva, Occupational Safety and Health Center in the Philippines, for her invaluable suggestions.

References

- 1) Knave BG, Wibom RI, Bergqvist UO, Carlsson LL, Levin MI, Nylen PR (1985) Work with video display terminals among office employees, II, physical exposure factors. *Scand J Work Environ Health* **11**, 467–74.
- 2) Sugita M, Minowa H, Ishii M, Etoh R (1986) Factors affecting subjective symptoms of VDT workers. *Jpn J Ind Health* **28**, 409–19 (in Japanese with English abstract).
- 3) Ministry of Labour, Japan (1998) Survey on technological innovation and labour. Tokyo (in Japanese).
- 4) Ministry of Health, Labour and Welfare, Japan (2002) Guidelines for industrial health controls of VDT operations. Kihatsu No. 0405001 (website: <http://www.jicosh.gr.jp/english/index.html>).
- 5) Website: http://www.niih.go.jp/en/gyouseki/result/pc_check/index.html

Appendix.

The first step  in creating a comfortable office

Action Checkpoints for Comfortable Computer Work

■
Do you feel aches or pains
when working with the computer?

■
Take a few moments to evaluate
your computer workstation
and work habits.

■
These Action Checkpoints will help you
assess your office
and find solutions to create
a comfortable work environment.

■

National Institute of Industrial Health

1

I Action Checkpoints

The key to avoiding aches and pains is to think about how you usually work with the computer. The Action Checkpoints allow you to self-evaluate 7 areas of computer work. Decision points are provided for each area of concern. After perform a self-evaluation of your computer work and reviewing the information gathered, you should ask yourself, "Is there anything that can be done to make computer work comfortable?" If you think improvement is "Necessary", check the box that corresponds to this choice. Or choose "Unnecessary" if your assessment tells you so. Rank the areas for improvement according to your priority. Now, you can efficiently work towards healthy and safe computing!

Actions for Improvement	Unnecessary	Necessary	Priority	Examples of Improvement
Adjust the room temperature, humidity and airflow for comfortable work.	<input type="checkbox"/>	<input type="checkbox"/>		(a) Air Conditioning
Adjust the position and brightness of the monitor to improve readability.	<input type="checkbox"/>	<input type="checkbox"/>		(b) Computer Monitor
Avoid continuous computer work. Take a break after every hour of work.	<input type="checkbox"/>	<input type="checkbox"/>		(c) Hours of Computer Work
Properly position the keyboard and mouse to avoid overreaching and awkward posture.	<input type="checkbox"/>	<input type="checkbox"/>		(d) Input Devices
Adjust the height of the chair and desk to fit your body.	<input type="checkbox"/>	<input type="checkbox"/>		(e) Desk and Chair
Neatly arrange documents and materials on top of and under the computer desk.	<input type="checkbox"/>	<input type="checkbox"/>		(f) Working Space
Find time to interact socially with the people around you.	<input type="checkbox"/>	<input type="checkbox"/>		(g) Social Interaction at Work

II

Computer Work and Discomfort

Eye strain, neck and shoulder stiffness and low back pain - these are some symptoms you may experience when working with computers. Having to keep the same posture over long periods of time is one of the main causes of physical discomfort. Improperly positioned keyboards or mouse also contribute to the discomfort. At the early stages of pain, the symptom disappears when a person stops working with the computer. The potential to develop work-related musculoskeletal disorders (WMSD)*¹, however, increases when computing tasks continue despite the presence of body aches. These musculoskeletal disorders would persist until well after work has ended.



Eye strain

Stiffness in the neck and shoulders



Pain in the arms and hands



Pain in the low back

Staring continuously at the monitor is another cause of discomfort from computer work. Furthermore, computer work tires the eyes because the short distance visual task puts much stress on the eyes' adjustment mechanism. In effect, workers complain of symptoms of eyestrain that include dry eyes*², eye irritation, burning sensation in the eyes, and blurring of vision. Though the symptoms do not progress to permanent vision problems, eye strain negatively affects productivity at work and more significantly a worker's attitude towards computing tasks. In addition to the above health problems, devoting so much time to computer work may lead to mental stress. Social isolation results from decreased opportunity to talk and interact with co-workers and less chance to foster social support that helps reduce stress.

III

How to Use the Action Checkpoints

The first step in preventing physical discomfort is for you to recognize its potential causes. The Action Checkpoints will assist you to evaluate your work and to find ways to improve working conditions.

Here are some important tips to remember when using this checklist:

- Actions for improvement are suggested measures in creating a comfortable work environment. Never assume that all of the recommendations would apply to your office environment. It is wise to select and adapt measures that you think would fit your work.
- Proceed with work improvements according to the priority you have set based on the findings of your self-evaluation. In this manner, you are addressing problems efficiently and systematically.
- These checkpoints may also be used to assess the computer environment of a group of individuals or for the entire office. You may find better solutions by discussing with other computer users.
- On the last page of this manual, you will find a pull-out poster "Quick Reference to Reduce Physical Discomfort from Computer Work". Post it where it can be seen easily and keep these suggestions in mind all the time!

*1 Work-related Musculoskeletal Disorders (WMSD) are disorders of the muscles, ligaments, tendons, nerves and bones that result from unfavorable work conditions such as repetitive movements, awkward posture, poorly designed workstations and long working hours. The symptoms may range from slight pain to muscle weakness, severe pain and movement disorder. Any part of the body may be affected such as the hands, neck, and shoulders. Other terms for WMSD are Repetitive Strain Injury (RSI), Cumulative Trauma Disorder (CTD) and Occupational Overuse Syndrome (OOS).

*2 Dry eye is a condition noted when the tear volume is significantly decreased or when there is qualitative change in the tears that lead to the drying of the surface of the eyes.

IV Examples of Improvements

(a) Air Conditioning

Symptoms & Causes

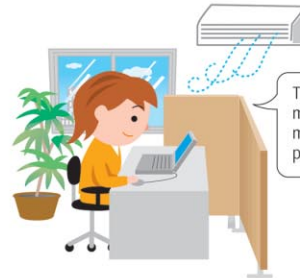
Symptoms of eyestrain and dry eyes result from exposure of the eyes to dry air or when air movement is fast inside the office. Tears evaporate easily under these conditions. Also, if the room is dusty, the particles may enter the eyes making the symptoms of eye strain worse. Exposure to cold draught decreases blood circulation and leads to slight tensing of the muscles in the affected area. Acute discomfort is felt usually in the neck, shoulders and back.

Improvement Plan

- Set the room temperature to 24-27 degrees Celsius during summer and to 20-23 degrees Celsius during winter. Maintain relative humidity of 40-70%.
- Optimum air velocity is 0.1 m/sec or less. If you are troubled by strong air coming from the air conditioner, you can use a partition to redirect flow of air.
- A humidifier may help increase relative humidity in your workstation.
- Maintain good ventilation in the room and do regularly housekeeping. Promote a smoke-free work environment.
- Make sure that you discuss these measures with your co-workers before changing anything. Remember that changes in the general work environment will likely affect the people around you.



Also note the direction of air flow when adjusting the temperature setting of your air conditioners!



The speed of air movement may be modified by using partitions.

(b) Computer Monitor

Symptoms & Causes

Too much contrast between the computer monitor and the immediate visual field burdens the accommodative function of the eyes and will likely lead to eye discomfort. A monitor positioned above eye level causes a larger area of the eye to be exposed to the physical environment. Tears evaporate easily and predispose the user to develop dry eyes and eye strain especially if the air is dry or if air velocity is high. In contrast, a monitor placed too low will lead to more bending of the neck and upper back causing neck-shoulder discomfort.

Improvement Plan

- Adjust the height of the monitor. Make sure that the top of the monitor is at or below eye level. Ensure that you will not assume awkward posture when viewing the monitor. For laptop computers, adjust the angle of the monitor until you find the optimal setting for viewing.
- Place the monitor at least 40 cm away from the eyes. Hint: The optimal viewing distance corresponds to an arm's length!
- Adjust the direction and angle of the monitor to avoid or minimize glares and reflections. You may find it helpful to position the monitor perpendicular to the light source.

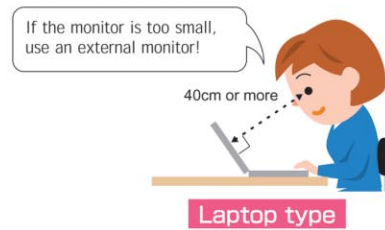
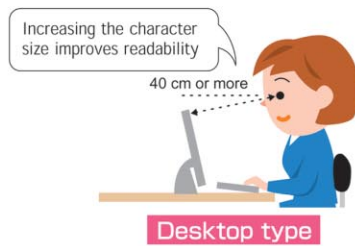


Adjust brightness of your monitor



Proper position your monitor to avoid glares and reflections

- Adjust the brightness and contrast of the monitor for easy viewing. When necessary, adjust the character size to increase readability.
- Use blinds or curtains to control the amount of light that will fall on your workstation. For light fixtures, use louvers or covers to decrease reflected light on the monitor.
- Avoid too much contrast between the monitor and the surrounding visual field. You may want to dim the general lighting level more than 300 lux. If you need more light for your desk task, use supplemental lighting.
- If you need glasses, you may consider using the glasses designed specifically for the viewing distance of 40-50cm.



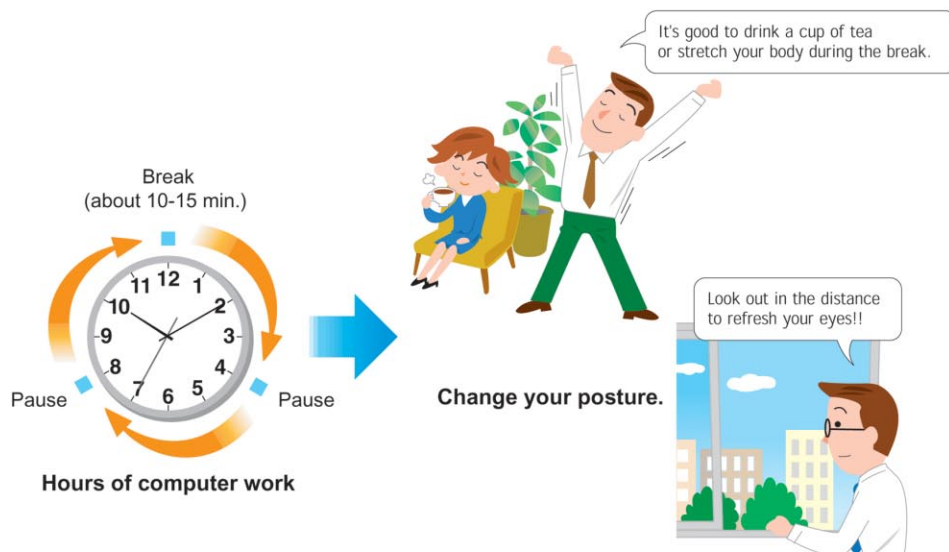
(c) Hours of Computer Work



Continuous computer work is a significant risk factor for work-related musculoskeletal disorders and eye strain. Computer work involves high repetitions and static or awkward posture. The constant loading of the muscles in the neck, shoulders and back will, in time, lead to aches and pains. The eyes, meanwhile, dry up from too much exposure to dry air. Also, a decrease in blinking rate as seen among computer users contributes to eye strain.



- A break of 10-15 minutes is recommended for every hour of continuous computer work. A mini-pause lasting for 1-2 minutes once or twice per hour of work is also recommended.
- Frequent changes in posture are a good measure against aches and pains. Leave your workstation to do stretching exercises. Perform exercises that will take you away from your computer desk. Rest your eyes by looking into the distance.



(d) Input Devices



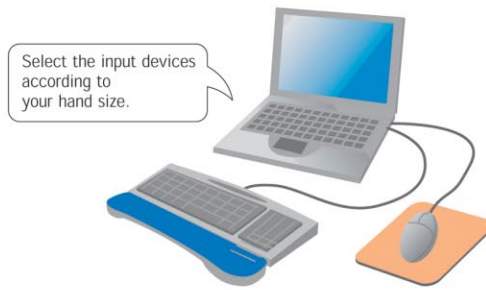
Risk factors of work-related musculoskeletal disorders may be present when you use input devices during computing tasks. If the keyboard and mouse are positioned too near or too far from the body, you will have to assume an awkward posture when using these devices. If you have a mouse that is too big or too small for you, you are giving stress to your shoulders, arms and hands. Unnatural movements of the fingers and hands are seen when doing shortcut keying. Inappropriately-sized keyboards also cause poor wrist position. Sometimes the work surface is too small leaving no space to support the wrist or arm. This condition leads to fatigue of the upper limbs.



- Place the keyboard and mouse within comfortable reach. The mouse should be positioned next to the keyboard. Both inputs devices must have the same height level.
- Adjust the height of your keyboard until your wrists are straight and until the forearms are parallel to the floor.
- Provide adequate space that you can use as armrest or wrist rest. For chairs with armrests, use this properly to remove postural stress from your body.
- Choose the type of input device that is fit to your body size. For instance, replace a big mouse with a smaller one to avoid discomfort.
- Use an external mouse when using a laptop computer. The use of internal mouse forces small awkward movements that may lead to discomfort. If you intend to use the laptop computer for a long time, the use of an external keyboard is also recommended.



Appropriately positioning the mouse and keyboard



Using the external keyboard and mouse

(e) Desk and Chair



If the chair or desk is not appropriate to your body size, you may have to hold an awkward posture that leads to symptoms of WMSD. Dangling feet brought about by chairs that are too high will impede blood circulation in the legs and contribute to back discomfort. Chair height that is too high also creates discomfort because of increased pressure on your legs and buttocks. On the other hand, a chair that is too low leads to elevation of the arms and shoulders.



- Use a chair with adjustable height and tilt. Select a chair that also provides adequate back support. For stability, choose chairs that come with 5 castors.
- If chair cannot be adjusted low enough and your feet are not firmly flat on the floor, you may use a footrest.
- If possible, use a desk with adjustable height.
- Make sure you understand how to adjust your chair and desk.



Appropriately adjusting the chair and desk

(f) Working Space

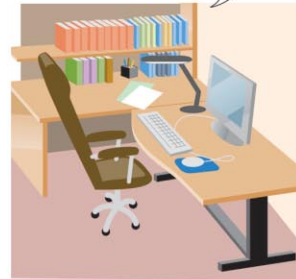


Enough working space is needed to accommodate all things needed when using the computer. Other than the monitor, the keyboard, mouse and documents are usually placed on the work surface. It becomes difficult to assume good working posture if there is inadequate space to properly position all objects on the desk. Restricted movements and awkward body positions will also occur if there is not enough legroom. Clutter under the table, thick desk top and desk drawers can cause obstruction to leg movements.



- Neatly arrange things placed on the work surface to allow enough area for computer work and other desk tasks. Things that you do not need or infrequently use should be removed from the desk.
- Use desk that will give you sufficient working space. A 1m² or bigger work surface may provide adequate room for computer work.
- If the working space is not sufficient for the keyboard or mouse, use an appropriate chair with armrests to support your arms.
- Remove clutter under the desk to provide leg room.
- Practice good housekeeping regularly. Devise a filing system for your paper work. Find a place for infrequently used office materials.

Before starting your work, neatly arrange the things around you.



Neatly arranged working space

(g) Social Interaction at Work



Social isolation is a consequence of devoting long hours to intense computer work. It decreases opportunity for interaction with co-workers and prevents the development of a social support system. It becomes difficult to seek technical assistance from co-workers when social links have not been formed. Symptoms of mental stress set in such as depression, withdrawal, fear of technology and confusion. Increased tenseness leading to musculoskeletal discomfort may become prevalent as well.



- Develop social relationships with co-workers who are also inclined to establish social links.
- Consult your health provider if you believe you are experiencing substantial psychological stress.
- Recommend to your supervisor or health provider that an area within the office be provided to encourage employees to get together and engage in informal talks. A refreshment corner may serve this purpose.
- Suggest to management that a technical support system be established to assist computer workers with technical difficulties. Advocate for technical training of all computer users to overcome technostress.
- Decorate your work space with pictures, plants or other ornaments that will help alleviate mental stress.

Start by greeting each other.



Conversation with colleagues and superiors

It's important to refresh your mind.



Creating the office environment where people can get together

